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The Early Stages of the Spectrum of Nova Herculis

By DEAN B. McLAUGHLIN

The astronomers whose schedules were so rudely interrupted in the middle of December have by now settled down to a new routine which includes the observation of Nova Herculis at every opportunity. It seems desirable at this stage of the work to make what a military commander would call an estimate of the situation. The account here given is based partly upon the observations at Ann Arbor, but in the first several days it depends on the piecing together of the fragmentary, often contradictory,—and in some cases surely erroneous,—early reports of the behavior of the spectrum of this remarkable object.

In compiling this history in a form as brief as is consistent with reasonable completeness, the names of some individuals and institutions may have become lost in the shuffle. Apology is made in advance for these sins of omission. In some cases it has been necessary to conclude that a report or some part of a report was erroneous and in some cases, while there is no proof as yet that statements are in error, special attention is called to discrepancies between statements from different institutions. This is done without any desire to criticise unfavorably the work of any person or institution, but in the hope that the discrepancies mentioned will be speedily cleared up and will not remain permanently on the record to confuse future workers on novae. Such criticism will be most useful if made now, rather than years hence.

From the later spectroscopic history of the nova and from a comparison of reports of almost simultaneous observations at different observatories, the writer is compelled to conclude that the early reports of the presence of the nebular lines were erroneous. It appears quite certain that those who reported them actually saw the lines $\lambda\lambda$ 4924, 5018, Fe_{II}. The situation is less certain with regard to reports of helium emission, but the later history of the spectrum renders it probable that what was observed was the blended pair $\lambda\lambda$ 5890, 5896, Na_I, and not 5876, He_I (D_3). Even at the date of writing, the helium emission is not conspicuous as compared with the sodium emission whose flanking absorption overlies the helium emission.

The spectrum of the nova was photographed at Greenwich on the morning of December 13, probably within an hour of discovery. The spectrum was fairly typical, showing emission bands of hydrogen bordered on their violet sides by absorption lines. Widths and displacements are only qualitatively referred to; the emission bands were

"wider than those of Nova Pictoris, but much narrower than those of Nova Aquilae." This description, and a comparison with data obtained at Cambridge twenty-four hours later, suggest a displacement of the absorption lines of the order of 500 km/sec. The Cambridge (England) plate taken on the morning of December 14 showed a displacement of that amount, and widths of the absorption lines of the order of five angstroms. At this stage hydrogen and enhanced iron emission were very prominent, and the star was remarkably strong in ultra-violet light.

We come now to the first apparent contradiction. At Leipzig, on the evening of December 14, displacements of —980 km/sec were observed. These were referred to as displacements of the absorption relative to the emission. This is apparently confirmed by observations at Potsdam, with objective prism, on "December 14 and 15" (hours not stated), the reported velocities being —1000 km/sec. But, on the evening of December 15 the nova was observed at Neubabelsberg and a number of lines were measured, the hydrogen lines giving velocities of roughly —400 to —460 km/sec, or somewhat less than the Cambridge value obtained some 36 hours earlier. The fact that observations on succeeding days showed a rather steady decrease of velocity casts some suspicion on the large displacements measured at Leipzig and Potsdam. The Leipzig velocity is stated in such a way as to suggest that it depends on objective prism plates; that from Potsdam is definitely stated to be so obtained. This raises a question as to possible systematic errors perhaps resulting from overexposure of the emission bands on plates of low dispersion. Another possible interpretation is that the velocity increased from 500 to 1000 km/sec in about twelve hours and decreased to its former value in about the same interval of time. Still another possibility is the fleeting appearance of strongly displaced absorption in addition to that of smaller displacement, and its subsequent disappearance. The writer does not feel that either of these two last named possibilities carries conviction.

From this point on the record is clearer. The observations at Kiel

TABLE I

ABSORPTION LINE VELOCITIES

	Dec. 13 A.M. Grwch.	14 A.M. Cambr.	14 P.M. Lpzg.	14-15 Potsd.	15 P.M. Berlin	16 A.M. Kiel	17 P.M. Ann A.	18 A.M. Ber.	19 P.M. Ber.
General	—500?		(—980)	(—1000)			—180		
Hβ					—446	—420	—311	—302	—280
Hγ		—500			—396	—360	—256	—241	—218
Hδ					—462		—226	—222	—202
4481, Mg II		—500			—218		—167	—166	—169
Si II					—180		—143	—140	—145
4352, Fe II							—185	—191	—190
4584, Fe II					—265		—218		
4924					—335		—245		—234
5018					—418		—197		
H and K							—207		—200

December 16, the Yerkes and Ann Arbor plates of December 17, and the Neubabelsberg observations on the 18th and 19th show clearly a decrease of the velocity, followed by an interval of constancy. The published data on velocities up to that time are summarized in Table I. Those which have been mentioned as doubtful are in parentheses.

During this stage the absorption spectrum closely matched that of α Cygni, and with the decreased displacement and consequent sharpening of both the emission and absorption lines the general appearance of the spectrum strongly resembled that of P Cygni, though different in its line pattern. During this stage the star was brightening. Probably about December 16 strong absorption lines of oxygen made their appearance. These were found at $\lambda\lambda$ 3947, 4368, 4970, 5330, and 6155. The line at 6155 was noted, but not identified, at Cambridge, and on December 18 Guthnick specifically mentioned two of these lines (but did not identify them) as having newly appeared since the 15th. This identification of O_I appears to be beyond question. They are, in fact, the *only* strong lines in the nova which are conspicuous by their absence in α Cygni. Further, they are the *only* lines of O_I in the observable region which are not badly blended with metallic lines. At the same time lines of the carbon atom were noted at Yerkes Observatory.

With the further brightening of the nova the emission lines became submerged by the strengthening continuous spectrum, until on December 21 the spectrum appeared to be almost without emission lines. On December 20 Moscow and Harvard reported the spectrum much altered. It was then practically a pure absorption spectrum of class cF5, closely resembling γ Cygni. On the other hand, Guthnick reported on the same date that the nova spectrum matched that of α Cygni line for line. This is not so great a contradiction as it may at first appear; α Cygni shows many lines rather conspicuously which are rarely seen so strong in spectra earlier than class F0. This spectrum, which the writer habitually refers to (in conversation with his colleagues) as the "Epsilon Aurigae stage," has persisted with decreased intensity to the date of writing.

The second striking contradiction is found in the report from Moscow, on December 22, of velocity displacements of 1000 km/sec for the hydrogen lines, and factors of the order of $20 \times 10^{-4}\lambda$ (equivalent to about 600 km/sec) for the displacement of the emission companions relative to the absorption lines. Since the emission band centers have been practically undisplaced, these two statements are evidently inconsistent with one another, and both are inconsistent with velocities measured before and after that date. Among the numerous reports on the spectrum about that time, no others mention absorption components with large displacements. The ϵ Aurigae spectrum evolved from that of α Cygni type without change of displacement. This is demonstrated by an underexposed, but conclusive, spectrogram taken at Ann Arbor on the morning of December 24, giving a velocity of —185 km/sec, in good agreement with that observed on December 17 (Ann Arbor), 18

and 19 (Neubabelsberg). However, we should not overlook the possibility that a strongly displaced set of hydrogen lines may have appeared, only to vanish after a day or so.

The maximum of light occurred on December 22. At that time the spectrum showed practically no emission. During the following four days the light declined through two magnitudes, and during this decline the emission bands of hydrogen and ionized iron again became prominent. At some time during this interval the ϵ Aurigae spectrum increased its displacement from —180 to —320 km/sec. The Cambridge observers mention that the velocity was decreasing from the 15th to the 18th, but that a "radical change" occurred between the 24th and 25th. This must refer to the increase of the velocity just mentioned. Between December 21 and 24, Harper found a change from —220 to —280 km/sec on ultra-violet spectra taken at Victoria. The change of velocity evidently was not quite complete on December 26, as an Ann Arbor plate then showed the absorption lines rather ill-defined, and the velocities given by different lines were much more discordant than on any other plates. With this increase of displacement the emission bands increased in width, their centers remaining practically undisplaced.

Another striking change also occurred during the decline of light. As early as December 24, Beyer, Merrill, and Harper observed an absorption band extending to the violet of λ 4215. It was stronger on December 25, when it was observed by Beyer and at the Lick Observatory, and probably reached maximum on the 26th when it was observed at Ann Arbor, Stockholm, and Lyons. A band head at λ 3883 and another at λ 3590 definitely identify the source as cyanogen. These bands were still strong on December 27, when the star was at a subordinate maximum, and by December 30 they had almost disappeared. They seemed to show no obvious relation to the light changes, as they continued to weaken when the star declined to its second minimum (December 29). Aside from the band absorption, the spectrum of the nova on December 27 is typical of its ϵ Aurigae stage. When the spectra of the nova and ϵ Aurigae are viewed on a Hartmann spectro-comparator the resemblance is little short of startling, even to most of the finer details of relative and total intensity of the lines. Only an occasional inconspicuous line, the emission bands, and the few lines of O_I distinguish the nova spectrum.

From this point on the Ann Arbor observations furnish a rather complete record of the changes of the spectrum, in both the visual and photographic regions. As early as December 27 the first feeble traces of more strongly displaced hydrogen lines can be distinguished, although they were first noticed on plates taken on the 30th, when they were still very inconspicuous, and only later were they traced back to the earlier date. By January 2 these new lines, with displacements of about —700 km/sec, were fairly conspicuous features, though not yet black. Similar second absorption components began to show feebly at the stronger lines of Fe_{II} about January 1. The doubling of the absorp-

tion lines of Ti_{II} followed during a cloudy spell from January 6 to 10. The lines H and K of Ca_{II} developed second absorption components simultaneously with those of Fe_{II}. The behavior of λ 4481, Mg_{II}, has been unique; it appeared sometimes single, more frequently as a close double, but the displacements did not always agree with those of other lines. When it was double the component of greater displacement usually gave a velocity greater than that of any other line in the spectrum.

There is no logical place at which to bring this history to a close except the date of writing. The developments during January and February may be summarized under six heads.

1. The ϵ Aurigae spectrum, including the first absorption components of Fe_{II} and Ti_{II} with displacement of —320 km/sec, weakened steadily without change of displacement until about January 20. Between that date and February 27 the velocity increased steadily to —380 km/sec. The weakening of the lines was almost imperceptible and it was only after a cloudy spell that it was realized, with something of a shock, that they were actually fading. The lines of H and Ti_{II} now (March 4) constitute the main part of the remnant of this spectrum,—even the lines of Fe_{II} are hardly distinguishable.

2. The second set of absorption lines, with displacement of —700 km/sec increased in intensity until they dominated the spectrum. The appearance of the second components for various elements proceeded in the order already named: H, Fe_{II} and Ca_{II}, Ti_{II}. Both Fe_{II} and Ti_{II} showed at first displacements of only —550 to —600 km/sec. From January 12 to 22, however, they shifted until their displacements agreed approximately with those of the hydrogen lines. At about the latter date the second absorption lines of Ti_{II} and hydrogen appeared to split into two components with velocities of roughly —800 and —650 km/sec. After that date the two strongly displaced lines of Ti_{II} faded and at the date of writing they have completely disappeared. The second components of the Fe_{II} lines are still conspicuous though weakened as compared with their maximum development. The second components of hydrogen have not yet declined perceptibly. The three elements thus show rather great differences of behavior; hydrogen now shows both the first and second lines, Fe_{II} only the second, and Ti_{II} only the first.

3. With the development of the second spectrum the emission bands increased in width. As the —700 km/sec absorption increased in intensity an extension of each emission band appeared on its red edge, with maximum displacement equivalent to about +700 km/sec. At first very weak, this "shoulder" increased in strength until, at the maximum development of the second absorption spectrum, it was almost equal to the original narrower core of the emission band. The region between the first and second absorptions did not increase so rapidly; it appeared as if a general diffuse absorption covered that region until about January 15 when, during a cloudy spell, it rather suddenly filled up with emission equal to that on the red side of the band. About February 5 the bands

of hydrogen reverted rather abruptly to the appearance they showed just prior to January 15.

4. Aside from the shoulders just mentioned, the emission bands were at first rather structureless. Beginning early in January, however, the H and K emission showed two maxima, one on each edge of the core of the band. The maximum of longer wave-length was somewhat the broader of the two, and it gradually increased in intensity until the first week of February, when it was a very striking feature. It then faded again and a sudden revival of its intensity on March 2 was most unexpected. Both these times of maximum strength of this feature are correlated roughly with minima of light of the nova. Simultaneously the bands of Fe_{II} showed a similar structure, though not quite so pronounced on the first occasion. The hydrogen emission bands very definitely do not share this behavior. There is a trace of such structure at $H\beta$ and perhaps at $H\gamma$, but $H\delta$ has always appeared quite structureless, and the admission of its occurrence at any of the hydrogen bands is made grudgingly. At the date of writing, the bands of Fe_{II} show this doubling of the core very remarkably. Each band appears as a widely separated equal pair of rather sharp emission lines. This structure is shown with equal distinctness by the auroral and nebular lines in the visual region. The meaning of these structures and their changes will not be interpreted at this time. In the H and K lines it seems to be associated with a doubling and smearing of the interstellar absorption, but in view of the appearance of similar structure at the nebular lines it seems probable that this suggestion is valueless. It may be mentioned in passing, however, that such behavior is not without a parallel; the nova "par excellence," Nova Aquilae of 1918, showed somewhat similar changes of emission contours, oscillating between "peaked" and "dipped" profiles, while Nova Herculis has oscillated between flat-topped and strongly "dipped" bands.

5. The principal nebular lines at $\lambda\lambda$ 4959, 5007 have not yet put in an appearance,—in fact they are not to be expected for some weeks if the rate of development of this nova in future is predicted by its leisurely behavior in the recent past. Very interesting developments have occurred, however. On December 17 very feeble traces of emission were noted about $\lambda\lambda$ 5990 and 6090. By December 26 these had increased to distinctness, and a line about λ 6020 had appeared. The origins of these emissions are unknown. The auroral line, 5577, O_I, was seen distinctly on December 26, as well as 6300, a nebular line due to O_I. Traces of 5680 and 5755, due to N_{II}, were seen. These lines just named have had rather different histories. The first three, 5990, 6020, 6090 reached maximum intensity about December 30 and had declined to insignificance by January 12. The auroral line, 5577, increased at first rather rapidly and then more slowly, and is now one of the most conspicuous features of the spectrum. Similar behavior has characterized 6300 and 6363 of O_I. The former is now outshone only by $H\alpha$. The lines at 5680 and 5755 remained very faint, and often indistinguish-

able, until about January 23 when they rather quickly increased and remained conspicuous. The changes just described are summarized in Table II.

TABLE II

VARIATIONS OF NEBULAR EMISSIONS

Wave-length	Origin	Dates first observed		Dates of rapid increase	Date of Maximum	Date of disappearance
		trace	conspic.			
5577	O_I	Dec. 26	Dec. 26	Dec. 26-30	future	future
5684	N_{II}	Dec. 26	Jan. 11?	Jan. 18-23	future	future
5755	N_{II}	Dec. 26	Jan. 24	Jan. 23-30	future	future
5876	He_I	Dec. 17	Dec. 30	Jan.	future	future
5990	?	Dec. 17	Dec. 26	Dec. 26-30	Dec. 30	Feb. ?
6020	?	Dec. 17	Dec. 28	Dec. 26-30	Dec. 30	Jan.11?
6090	?	Dec. 17	Dec. 28	Dec. 26-30	Dec. 30	Jan.11?
6300	O_I	Dec. 26	Dec. 26	Dec. 26-30	future	future
6363	O_I	Dec. 26	Dec. 28	Dec. 26-30	future	future

6. The changes of the absorption and emission of sodium have differed somewhat from those of other lines. On the first panchromatic plate taken on December 17 the D lines are present as very fine and weak absorption flanked on the red side by very feeble emission. The emission became very conspicuous by December 26 and continued to increase until about the end of January. The first absorption became fairly conspicuous, but was soon overshadowed by the tremendous development of the second absorption which occurred simultaneously with that of Ca_{II}. At the present writing both the emission and the absorption of sodium have declined somewhat, but they are still among the most conspicuous features of the spectrum.

Already the prophecy of future changes is faintly written in the spectrum. On some of the most recent plates a patch of emission has appeared on the violet side of the second absorption at Hβ and the two Fe_{II} lines 4924 and 5018. A smudge of feeble absorption to the violet of this new emission is suspected. It appears probable that a third absorption spectrum is about to emerge with displacement of the order of —1400 km/sec. A very extensive faint emission symmetrical about Hδ, and with diffuse absorption on its violet edge is seen on a couple of recent spectrograms. This is probably the first trace of the band of N_{III} at 4097-4303 and indicates the approach of the Wolf-Rayet stage of the nova. Helium emission has not yet appeared at 4472 and 4026, but faint traces of the absorption in the latter position have been suspected recently.

In all its changes this nova is particularly deliberate and apparently very considerate of astronomers situated in climates like that of Michigan. The opportunity to study the changes of these enigmatical stars is unprecedented. It should add particularly to our knowledge of the changes of emission lines in the visual region of the spectrum,—changes which it was not possible to study intensively in the previous bright nova of leisurely behavior, Nova Pictoris, which seems to have proceeded through its changes in a manner closely parallelling that of

Nova Herculis. V. M. Slipher pointed out the similarity of the spectrum to that of Nova Aurigae, 1891, and on that basis he predicted the leisurely character of this nova.

Reproductions of the spectrum of the nova on four dates are given in Plate III for the photographic region and in Plate IV for the visual region. Most of the features mentioned in the foregoing description are indicated. It should be explained that the comparison spectrum was adequately exposed on these plates, but in the several photographic processes it has been partly lost. Some slight abnormalities of distribution of energy in the continuous spectrum have resulted from the necessity of piecing together different portions of the spectrum, an undertaking which has met with variable success. With these limitations in mind, it is still hoped that these enlarged spectra, with the foregoing description, will serve to give a clear picture of the changes for those who are not so fortunate (or unfortunate, depending on point of view) as to have access to a spectrograph.

The time for physical interpretations lies in the future. It can hardly be doubted that some substantial advances in our knowledge of the physical processes which take place in novae will result from the study of this unusual object which is now being subjected to the combined attack of more powerful equipment than has ever before been trained upon a single star.

THE OBSERVATORY, UNIVERSITY OF MICHIGAN, MARCH 4, 1935.

PURPOSE

(To Fomalhaut viewed from a northern clime)

O Fomalhaut,
May I like thee
Give out sustaining
Light serene
To those that love
God's law.

Apart from the
Gay galaxy of stars
O'er-head,
When autumn lengthens
Night,
Thy clear light
Glows.

Humbly completing
Thy lowly arc
In sight of man;
In truth,
Continuing eternally
The cycle of
God's plan.

—F. vonK. B.

425 Brattle Road, Syracuse, New York.

The Astronomical Fraternity of the World

By DAVID B. PICKERING

PART XIV

The second day of our visit on Mt. Hamilton began with a breakfast of griddle cakes served around a large table in the community dining room. It was here that Mrs. Corona catered to all members of the staff except those family folks who had their own homes. After breakfast, on my way to take some pictures, I met Dr. R. J. Trumpler, properly keyed up to holiday mood, who was about to start with his family upon the first leg of a trip to his native Sweden, where he was to spend his sabbatical year. The ancient automobile in which they were to leave was so packed to the roof with so many kinds of luggage that it seemed a mystery how the Doctor and Mrs. Trumpler and their boys and girls could pack themselves in as well. We called on Mrs. Trumpler later in the day, to wish them a fine trip, and about her plump and animated person swarmed youngsters of that irrepressible boy and girl age that lies between eight and twelve years. There was an older Trumpler daughter at home in Sweden who was surely looking forward to a reunion with her parents and those four younger brothers and sisters.

After leaving Dr. Trumpler, I strolled along the road that wound between the scattered cottages, and soon came upon a couple of sprites sprawled upon a platform by the roadside. These two diminutive females were clad only in breech-clouts, their hair bleached and their bodies browned by the sun. "And who are you?" said I. "I'm Susanne and this is Elizabeth," said the elder fairy, filled with the self-reliance and boldness of all her four years, "Who are you?" "My name is Pickering," I told her. At this Susanne bounced up like a rubber ball, and leaving her eighteen month old sister sitting round-eyed on the platform, grabbed my hand and started dragging me toward the next dwelling. "Mother, Mother," she called, "Here's the man who's coming to lunch with us." As a window shutter was opened from the inside, Susanne whispered to me, "What did you say your name was?" Again I told her and she properly introduced me to her mother.

And so I met Florence, the wife of Dr. Donald H. Menzel, whom we had last seen in 1923 at the spring meeting of the A.A.V.S.O. That was the memorable occasion when Charles Elmer gave us the big clam-bake on the beach, in front of his home at Southold, L. I. At that time, eight years before, Don was working at the Harvard College Observatory for his Ph.D. Susanne was quite right, for after I had come back from my picture-taking trip to "Kepler," Dr. Farnsworth was ready to conduct Mrs. Pickering and me to the Menzel's for lunch. There, with big, curly-haired Don and his slender, girlish wife were two rosy young ladies, pinkly beribboned and demurely polite, two wild birds that had

been caught in the sun, and put in cages of starchy clothes. It was lots of fun talking over the times when Don was a bachelor in New England, and listening to Florence, bright-eyed and vivacious, tell of their happy family life, and Susanne and I had fun demurely winking at each other in token of our earlier meeting that morning.

FIGURE 1.
HOME OF THE 36-INCH CROSSLEY REFLECTOR.

After lunch we drove with Don and Alice to see the Crossley reflector. There we found that quiet, serious young astronomer Dr. S. L. Thorndike, who joined our party. The style of the mirror and its trappings, under the old iron dome, told plainly that it was not of modern origin. There were heavy ropes dangling from places overhead, and big gadgets here and there that might be used for taming the monster if he grew unruly. The fact that the mirror was ground by Sir Howard Grubb

and the mounting made by Dr. A. A. Common places the era of its creation. All the expense of bringing the telescope and the dome from England was met by subscriptions from the citizens of California. What a boon to astronomy, when, 40 years ago, this first of the big mirrors was erected on a western mountain site! The advantages of the reflector for certain kinds of photographic work were long ago recognized and many important discoveries were made with the Crossley instrument. With it was found the sixth satellite of Jupiter, from a plate taken in

FIGURE 2.
DR. ALICE H. FARNSWORTH AND THE SCREEN OF THE CROSSLEY REFLECTOR, THROUGH WHICH HER SPECTROGRAMS WERE MADE.

December, 1904. Then the seventh satellite in January, 1905, and the ninth in July, 1914. It was used photographically in important investigations of planetary and other gaseous nebulae, as well as in the study of star-clusters. Furthermore, it added many hundreds of "Island Universes" to the few dozen previously known.

During her stay on Mt. Hamilton, Dr. Farnsworth had been engaged in making spectrograms of cluster-type variables through the 3-foot wire screen attached to the Crossley reflector and then studying these with the aid of the Moll Registering Micro-photometer. In this original method for obtaining the color indices of the variables, the first order spectra of the stars is recorded upon a cylindrical roll of sensitized

paper. The records show a high curve at the densest part of the image in the color of greatest intensity. When plotted and measured on reticulated paper, comparative color values are readily obtained. It was this unique bit of research that Dr. Farnsworth had chosen to give spice to her holiday.

At four o'clock we arrived at the home of Professor and Mrs. Wright, where we spent a couple of hours dividing our attention between tea and bridge. The former was made especially attractive by a culinary stunt of Mrs. Wright's which consisted in mixing grated orange rind with the sugar which was applied to the surface of the hot,

FIGURE 3.
IN MRS. WRIGHT'S GARDEN.
Left to right: Mrs. Pickering, Mrs. Wright, Dr. Farnsworth, and Professor Wright.

buttered toast. Alice "Kibitzered" during the bridge game, in which Professor Wright and Mrs. Pickering played against Mrs. Wright and me. The former won, even though Professor Wright forgot to score 100 honors in the last hand, as he confided to us next day. There were two members of the Wright household responsible for what dignity the party possessed. With deliberate stride, their plumed tails gracefully swaying, these purring Persians rubbed themselves against our ankles and responded languidly, if at all, to the names Diablo and Angelica. I think I forgot to say that a similar pair grace the home of Professor and Mrs. Moore. The latter are named Bozo and Mirza. It isn't easy to live up to the air of respectibility which such august felines impose upon a household. It would be difficult to act really silly with a Persian cat of staid maturity as an audience.

Professor Wright has been on the Lick staff for 34 years and is junior only to Professor Aitken. As we enjoyed the view across the valley to the south, beyond which loomed Mt. Isabelle, Professor Wright told us of his continued work in obtaining motion pictures of Jupiter and of Mars and of his coming publication on the novae. We discussed the plans for the meeting of the International Astronomical Union in 1932 and lived over again the Leiden meeting of 1928.

After a stroll in Mrs. Wright's garden, surrounded by its low retaining wall, we returned to the dining-hall for a dinner of fricasseed chicken and cold, yellow cantaloupe.

FIGURE 4.
WATCHING THE SUNSET FROM THE PARAPET.
Left to right: (standing) Dr. Whipple, Dr. Thorndike, Mrs. Pickering, Miss Potwin, Dr. Farnsworth. (sitting) Miss Stillman, Miss Hayford, Dr. Anderson.

The sun was close to the horizon on the starboard bow of our "battleship" as we mounted the "chicken-walk" and sauntered around the observatory to the western parapet. It was obvious why this spot had been chosen as a gathering place at sunset time, and why such meetings had taken on something of the character of vesper ceremonies. The valley was bathed in orange light. Down the nearer slope of the mountain scampered the rabbits; squirrels played about the tree limbs and across distant clearings the deer loped in undulant strides. After the sun had set, the west became hazy with a gray mist that rose from the shadows of the valley. We spoke, quite properly, less often and in

lower tones. And then, one by one, the stars came out. It was dark when we reached Alice's sitting-room in the dormitory, where a grate-fire was roaring with its fuel of pine cones—and what food they are for the open fire! The Menzels dropped in before we were fairly settled around the hearth, and Don invited me to join him later at the Crocker telescope. Then came Dr. Aitken, in leather jacket, to do his trick at the 36-inch refractor, and asked us to join him in the dome after he had made all ready. And so we soon had the enviable thrill of studying the details on the surface of Mars and Jupiter through the world's second largest refractor and, with Dr. Aitken as show-man, this was certainly the high-spot of our visit.

It was not, however, until the glass had been directed to the moon that I realized the resolving power of this mighty lens. We used powers of 250, 500, and 1000 and it would be futile to attempt to describe the clear and minute detail these displayed. I remember once in a dream seeing the sky as it might appear through a great telescope having a visual field of 180 degrees. I was reminded of this when I saw the moon through the Lick telescope. Dr. Farnsworth and I discovered near the terminator, a mound within a crater, later identified as John Herschel, whose shadow showed it to be distinctly forked. The twin shadow peaks were but barely separable even with the highest power. Dr. Aitken said that he and Professor Campbell had found so many, such as this, that they were convinced of the volcanic nature of their origin. We watched the operation of the movable floor which travels through a distance of 16½ feet, and realized that this was the first of its kind. Then Dr. Aitken showed us the trick of rolling into our seat on the observing platform, instead of the more awkward method of backward climbing while facing the ocular. After we had returned to the burning pine cones and Alice had shown us her scrap-books of astronomical things, Dr. Thorndyke came in with his violin. He played some of the old classics to Alice's accompaniment, and Alice, to our surprise, proved herself a capable musician. It so happened that we had never known of her love for music and the study that she must have given it.

Sometime before midnight I went off to meet Dr. Menzel, and found him at the little house of the Crocker telescope, that stands high on the southern slope of the ridge to the east of the dormitory. There is a dark-room next to the dome, and here Don was filling some plate-holders, but by the time he was ready to expose for certain areas in Scorpio, the southern sky had become a bit misty and we decided to wait it out We went outside and sprawled on the steps that face the west.

Away in front of us the white dome of the big refractor loomed ghostly against the moonlit sky. Here Don told me a lot about the observatory program and of his own work in particular. Donald Menzel, as thinker and theorist, has the knack of dove-tailing evidence into plausible hypotheses, of building a concrete structure of knowledge from observational bricks that are scattered here, there, and everywhere. The Lick program included 2½ nights weekly of observational

work for each member of the staff, but one could be pretty sure that it was not this feature that Menzel regarded with the greatest enthusiasm. Even then his office contained the proof-sheets of an exhaustive work on the solar atmosphere, since published and acclaimed, wherein he interprets the flash spectrum from a mass of all-time data. His deductions call for a deeper, more rarefied solar atmosphere than was thought to exist before. He had found those "hot-spots" in which the elements were highly ionized and related them to the prominences and, perhaps, to the faculae. He talked of the many problems involved in such a work as this and explained some of the observational refinements that

FIGURE 5.
DR. DONALD MENZEL AT THE RIM OF THE CROSSLEY REFLECTOR.

have been used to get fuller evidence of the solar constitution and temperatures. We talked on like the walrus and the carpenter far into the why and wherefore, until the insects had quit singing, and the morning constellations were well up in the east before I crawled up the "chicken-walk" and fumbled along dark hall-ways until I found my room.

As we started down for breakfast next morning we saw that the valley was filled with a billowing sea of fog-cloud. The battle-ship effect of the promontory was more striking than ever and I turned

back to get my camera, as this was one of those spectacular things I had hoped to see and record while on the mountain.

Dr. Farnsworth called to me that it would still be there after breakfast, so why bother to go back now, and so, because very naturally I had grown to believe everything that Alice Farnsworth said, I lost my chance to get the coveted picture.

When we came out of the dining-hall, the mist in the valley was a thing of shreds and patches. Like a mother whose youngster refuses to recite his piece for her guest, Alice protested that "it had never acted that way before" and I think felt worse about it than I did. Shortly afterward I was sitting on the front porch of the Aitken home where the "First lady of the mountain" was showing me the pictures in her scrap-book and regaling me with more stories of the past. She told me how she and Dr. Aitken had met as students in the Oakland High School, and when it was decided that only one of them could go to college, he would send her from Williams the work that he had been doing so that she could keep up with his progress. Then she said, "but when we attempted to go beyond calculus, I just balked." She told of her experiences as first teacher in the mountain school, when the class consisted only of her own children and those of Mrs. Campbell; of the days when part of her job was to drive a team into San Francisco for supplies and supervise the catering to the thousands of visitors to Mt. Hamilton, and those engaged in the many eclipse expeditions undertaken by the observatory. It was no wonder that she came to be known as "The Secretary of the Interior."

I went back with Dr. Aitken to the Post Office, which was located in one of those low buildings that connect the dormitory with the observatory. Members of the staff take their turn, for a few years each, in acting as Post Master. At that time Dr. H. M. Jeffers was the man behind the cage, and when we arrived he was busy with the morning delivery. It looked like mail time in a country store and among those who stood around waiting for favors was Professor William Wallace Campbell. It was the first time we had seen this big, iron-gray man, who for thirty years had controlled the affairs of the Lick Observatory. He was large of frame and feature and his eyes sparkled beneath his famous and extensive eye-brows. His greeting was energetic and wholesome. At his feet was a little white dog who was the only canine inhabitant of the mountain and whose home, fortunately, was far removed from those of the proud Persians at the Moore-Wright end of the colony. Professor Campbell had been President of the University of California for a number of years during which he held his post as Director of the Observatory. Only then was he about to relinquish this latter office to Professor Aitken. At the time of our visit, Mrs. Keeler was a house-guest of the Campbells. It was her husband, James Edward Keeler, whom Professor Campbell had succeeded as Director. Professor Keeler held the office less than two years before his death, but what a record of accomplishment is crowded into that short while! He was

buried at the base of the telescope that bears his name in the Allegheny Observatory, of which he had been Director before going to Lick. By his side rest those other pioneers, Uncle John and Phoebe Brashear. Everybody knows the quotation that marks this tomb: "We have loved the stars too fondly to be fearful of the night."

After luncheon we went to Miss Stillman's room. Never be surprised at learning of the hobbes of astronomers. Dr. Shapley has his ants, but "Pat" has her elephants. There were racks and shelves of them, in jade and ivory, china and plaster, bronze and wood. They were woven in rugs and worked into pillow-cushions and many were from far parts of the world. As she told us stories of their capture, it did not seem at all strange that she should be playing Mahaut to these majestic beasts. From her zoo, "Pat" took us to a large room near the Post Office, to see the clocks. There we found products of Shortt and Riefler. There were ten of the pendulum type and three chronometers. There, also, was the 6½-inch Clark Meridian Circle which, with the possible exception of that in Washington, is the largest instrument of its kind in America.

At one side of the room was something that looked like an ancient, red bed canopy, covering odd lengths of stove-pipe. This, I think, was a device for throwing a beam of light upon a mirror set in the hills three miles away at a point on the meridian, making a false star with which to check orientation.

In the cellar we saw the Riefler master clock which, though it had been moved into a new position six weeks before, was keeping time to within 1/100 of a second daily. Down there, too, were the seismographs, vertical and horizontal, with their carbon record rolls. We came upstairs to meet the "Time Man" of the observatory, Dr. Jeffers, whose office is at the side of the big room we first visited. He was surrounded by his radios as he showed us his own transmitting set and that through which he receives the long-wave signals from abroad, as well as those from Arlington. Dr. Jeffers was dark and slender and neatly dressed. Because of his careful and precise manner he seemed just the man to have charge of these high-strung, temperamental instruments.

It was nearly time for us to leave, but I dropped in upon Becky Jones for a minute to watch her examining plates with a low-power microscope. She was determining the amount of displacement of the lines of spectroscopic binaries.

Then I went to Professor Moore's office, where he showed me some of his spectrograms of such binary systems as Castor and Polaris. Each image was about 11½ inches long by 2½ inches wide and the scale was 7 angstroms to the millimeter. The Doppler shift was measured against the usual H and K lines of calcium and the radial velocities of each component determined. There were some stars of this type where the angular separation of the components was 1/10 second of arc. Professor Moore has a good voice and the knack of making his explanations clear and interesting. He showed me a beautiful spectrogram of Saturn

and pointed out how obviously it proved that both planet and rings revolve in the same direction. He told how he and Donald Menzel had determined the period of rotation of Neptune in 1928, at something more than 15 days, and what a thrill they had in discovering that the rotation was normal, from west to east, though its contrary satellite moved in the opposite direction, suggesting an adopted body.

It was not easy to tear ourselves away from so much that was interesting and entertaining, and from those who had made us feel so at home during our stay, but it had to be. We stowed our luggage in the car and waving good-byes rounded the prow of the "battle-ship." From the next lower plane we glanced up at the great dome above the parapet, but it was only a glance for we had to give all our attention to those hundreds of twists and turns which at last eased us into the sunny valley below.

EAST ORANGE, NEW JERSEY, FEBRUARY 13, 1935.

The Selection and Prediction of Occultations for any Place and Time

By ISABEL M. LEWIS

The method outlined in this paper for the selection and prediction of occultations visible at any place in a given interval of time is based in principle upon a method described by Wm. F. Rigge in "The Graphic Construction of Eclipses and Occultations."*

Changes have been made in the method of using the chart described therein in order to facilitate the rapid selection of stars to be occulted, especially faint stars for which the elements are not given in the *Ephemeris*. Tables have also been constructed for obtaining by interpolation the elements, x′, y′, and Y. The use of the chart in this case was not considered by Rigge, but it is now of chief importance in view of the fact that occultations of faint stars are being observed to a great extent at observatories in all parts of the world. Before considering in particular the procedure in the selection of stars for which the elements are not known in advance, the construction of the chart will be explained briefly. The substitution of a strip of celluloid equal in width to the diameter of the moon on the scale adopted, in place of a lunar disk, with its central line divided into millimeters, and the use of millimeter paper are two changes which it is believed will be found to be of great advantage in the application of this method. The reader is referred to the above-mentioned publication for a more detailed description of the principles involved in the construction of the chart than can be given here.

The chart is illustrated in Figure 1 for a place in latitude 42° 30′

*Chap. IV, Pages 60-65.

north. If it is inverted and N. and S. interchanged, as well as the signs of the declinations, indicated on each ellipse, it will be applicable to a place in the corresponding latitude of the southern hemisphere. Once constructed for any latitude the same chart may be used indefinitely at the place of observation or *any* place in that latitude.

The first step in the construction of the chart will be to draw, on millimeter paper, a circle of radius ten centimeters, to represent the earth's disk. Then draw through the center of the disk the two coördinate

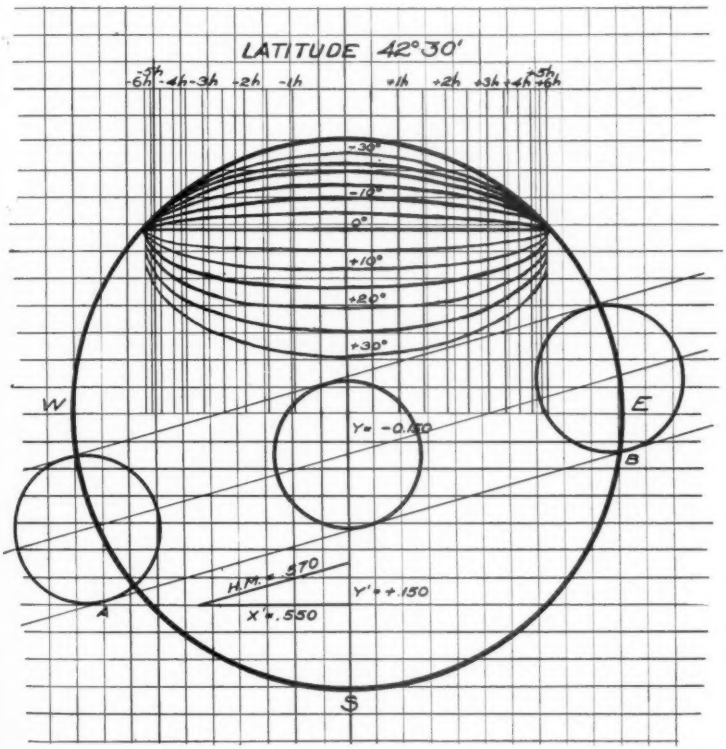

FIGURE 1.

The chart as it appears constructed for Lat. 42° 30′ N. AB represents the celluloid lunar strip placed with center on the Y-axis at the point $Y = -0.150$, and with its slope corresponding to $x' = 0.550$ and $y' = +0.150$, the hourly motions in the x and y coördinates, respectively, expressed in units of the earth's radius. The corresponding hourly motion of the center of the moon along its path is 0.570 or, on the scale adopted, 57.0 mm. In the reproduction of the chart here it has been necessary to reduce the scale because of the limitations of the page. From the position of the strip it is evident that with the above values for the elements x′, y′, and Y no occultation is possible in the given latitude, whatever the declination of the star.

axes at right angles to each other. The horizontal, or X-axis, lies in the plane of the earth's equator, and the axis at right angles to it, the Y-axis, represents the meridian in longitude H from Greenwich which star and moon are transiting at time of geocentric conjunction in right ascension, west is at the left and north at the top of the disk.

Ellipses are now to be constructed which represent the path of the place across the earth's disk from west to east as viewed from the direction of the star, which is above the plane of the paper and in a direction at right angles to it. The coördinates of any point on an ellipse referred to the two coördinate axes are ξ and η in which ξ is the distance measured west or east of the Y-axis, negative toward the west and positive toward the east, and η is the distance north or south of the X-axis, positive above the axis and negative below it. They are computed by means of the following formulae:

$$\xi = \cos\phi \sin h$$
$$\eta = \sin\phi \cos\delta_s - \cos\phi \sin\delta_s \cos h$$

in which ϕ is the latitude of the place, δ_s the declination of the star, and h the stellar hour angle, or the hour angle west or east from the Y-axis. The ξ coördinate corresponding to any given value of h is the same for all ellipses, and, in constructing the ellipses, values of ξ are computed for every half hour of h up to and including the value of h corresponding to the star's semidiurnal arc; the value of ξ corresponding to the latter value of h will, when plotted, give a point on the earth's disk at the point of intersection of the ellipse with it. Draw lines parallel to the Y-axis through the values of ξ corresponding to every hour of h. The place will be at one of these points on its ellipse when it has the stellar hour angle h corresponding to it. These points are called the time points and are convenient in estimating the position of the place when it has any given hour angle. Half hour or even ten minute points may be marked on the ellipses if desired. After the coördinates have been computed, the ellipses may be drawn in free hand. Coördinates computed for every half hour of h will be sufficient for this purpose. Indicate on each ellipse the declination of the star to which it corresponds, as in Figure 1. The semi-major axes of all the ellipses are the same and equal to the cosine of the latitude, ϕ. The semi-minor axis of each ellipse is equal to $\sin\delta_s \cos\phi$. The point of contact of each ellipse with the circumference of the earth's disk gives the position of the place when on the horizon, at which time the star is rising or setting as seen from the place; rising when the place is on the *western* edge of the disk, and setting when the place is on the *eastern* edge of the disk. The ξ and η coördinates for the points of intersection of ellipse and disk are obtained from the formulae:

$$\cos h = \tan\phi \tan\delta_s$$
$$\eta = \sin\phi \sec\delta_s$$

There will be two points for each ellipse, one on the left edge of the

disk corresponding to the negative value of h, and the one on the right edge corresponding to the positive value of h.

This completes the drawing of the ellipses and the charts. It will be sufficient to draw in ellipses corresponding to every five degrees of declination between $+30°$ and $-30°$, which are the limits in declination for occulted stars. The positions of intermediate ellipses can be estimated with sufficient accuracy for approximate predictions. If preferred, ellipses may be plotted for every two degrees. In the selection by this method of stars to be occulted, it will not be found necessary to apply the reductions from mean to apparent place, as this correction will change the position of the star relative to the moon's path only through its effect on the position of Y and at most will shift the position of the moon's path on the chart only about one millimeter. This would affect the times less than a minute at most and raise the question of visibility only in the case of grazing occultations, which are of little value, as are also occultations observed near the horizon.

We now wish to represent the path of the moon across the earth's disk as viewed from the position of the star. An occultation is analogous to an eclipse of the sun by the moon in which the star takes the place of the sun. Since the star is at an infinite distance from the earth, compared to that of the moon, the elements of the shadow-cone of an eclipse become elements of a right circular cylinder enveloping the lunar disk in case of an occultation. When the place as seen from the star, or the star as seen from the place, is in line with an element of this enveloping cylinder, the beginning or ending of an occultation, the immersion or emersion, respectively, is occurring at that place.

Let us now represent the path of the intersection of this cylinder with the earth's disk, or the lunar disk projected upon the earth's disk, by a transparent strip of mica or celluloid exactly $54\frac{1}{2}$ mm wide and about 20 cm long. The exact length is immaterial, but the width is the diameter of the lunar disk in units of the earth's disk which on the chart is taken as 20 cm. The ratio of the moon's radius to that of the earth is 0.2725, and therefore the width of the lunar disk on the scale chosen must be $54\frac{1}{2}$ mm. It will be found convenient to inscribe in this strip a lunar disk at the center, and one at either end with circumferences graduated to whole degrees. The central line of the strip should also be divided into millimeters. A ruler marked with a centimeter scale will also be found useful, but not essential, in fixing the slope of the path.

It is now our aim to determine whether the place in which we are interested will come within the radius of the lunar disk as it moves along this strip across the earth's disk from west to east. Before explaining how this is accomplished we will briefly mention the elements required and their use in this connection.

The elements x' and y' represent the motion of the center of the lunar disk with respect to the X and Y axes, respectively, in one hour. Y is the intercept of the moon's path on the Y-axis. It is equal to the difference in declination of the star and moon at time of geocentric conjunc-

tion divided by the parallax of the moon, which is the angle subtended by the earth's radius as seen from the moon, and is obtained from the formula:

$$Y = (\delta_m - \delta_s)/\pi_m$$

The value of Y may be taken from a table in which the arguments are the differences in declination of star and moon, and the parallax of the moon. Tables have also been constructed giving x′ and y′ in terms of the arguments upon which they depend. With the aid of these elements, which can be obtained very easily by interpolation from the tables, when the elements of occultation are not given in advance, it is possible to select stars that will be occulted at the place from any mean place list of stars for the beginning of the year. For stars brighter than magnitude 6.6 these elements are published each year in the *American Ephemeris*.

Before considering the elements H and T and their use, it will be shown how the path of the moon is located when x′, y′, and Y are known.

The distance x′ is laid off along the X-axis toward the *left* from the center of the disk. As it is expressed in units of the earth's radius it must be multiplied by ten to change it to centimeters. The value of y′ is also changed to centimeters and laid off from the center of the disk along the Y-axis, toward the north if the sign is positive and toward the south if it is negative. If the value of Y is small, lay off the value of x′ on a line several centimeters below the X-axis and parallel to it, instead of on the X-axis, and measure the value of y′ north or south from the point of intersection of this line with the Y-axis, to avoid conflicting with the strip representing the moon's path. After measuring off the values of x′ and y′, place a ruler along the diagonal of the rectangle, of which x′ and y′ are sides. The direction in which this ruler lies is parallel to the direction in which the moon's path crosses the earth's disk, and to get the correct slope of the moon's path to the X-axis, place the lunar strip parallel to the ruler. The length of the diagonal in centimeters is equal to the hourly motion of the moon's center along its path. This will be approximately equal to the diameter of the lunar disk, as the moon moves a distance approximately equal to its own diameter in an hour. Now that the slope of the path has been found, it is necessary to locate the point at which it crosses the Y-axis. This is given by the value of the element Y, published in the *Ephemeris* or taken from the tables with arguments $\delta_m - \delta_s$ and π_m, in case the elements are not published. It, also, is expressed in units of the earth's radius and is plotted in the same manner as y′, on the Y-axis from the center of the earth's disk toward the north if its sign is positive, and toward the south if its sign is negative. It will soon be seen that Y is rarely negative for occultations visible in mid-latitudes of the northern hemisphere, and rarely positive for occultations visible in corresponding latitudes of the southern hemisphere. With a little practice the reader will find that he can often settle the question of the visibility of an occul-

tation at this point merely by an inspection of the slope and the sign and magnitude of Y taken in connection with the observed declination of the star to the nearest whole degree. A recognition of this fact will save a great deal of work in selecting stars to be occulted, at the given time and place. It requires but a few seconds to place the moon's path in the correct position, knowing x′, y′, and Y. A star will then be rejected without further examination if it is evident that the ellipse along which the place is moving, namely the ellipse marked with the declination nearest to that of the star in question, can at no point come within the strip which represents the path of the projection of the moon's disk across that of the earth. If, however, the ellipse corresponding to the star that is being examined comes inside the strip at any point, it is to be further tested for visibility, as explained below.

The element H is the common Greenwich hour angle of star and moon at time of geocentric conjunction, T, when, seen from a place in longitude H, star and moon are on the meridian. If λ is the longitude of the place we are considering, then H-λ is the *local hour angle* of the moon when it is on the Y-axis, and therefore H-λ is also the stellar hour angle of the place on its ellipse at that time. In other words, when the moon is at the point where its path crosses the Y-axis, the place is at the time point H-λ on its ellipse. If H-λ is negative, the place will then be *left* of the Y-axis, and if H-λ is positive, it will be east of the Y-axis. This gives the *relative* position of the place and the moon at the time T of geocentric conjunction when the moon is on the Y-axis. The successful application of this method depends on a clear understanding of this fact. Both moon and place are moving across the earth's disk from west to east. The moon is moving onward in its orbit from west to east, its disk projected upon that of the earth; the place is carried across the disk by the diurnal motion of the earth on its axis. In one hour the center of the moon will move eastward along its path a distance approximately equal to its own diameter, and the place will move along its ellipse a distance between the time points, which correspond to two successive stellar hour angles. Knowing the relative positions of the moon's center and the place at the time T when the moon is on the Y-axis and the place is in stellar hour angle H-λ, it is possible to determine readily whether the place can come in contact with the moving lunar disk, and if so, when this will occur. An immersion will occur when the place is on the eastern, or preceding, limb of the moon, and an emersion will occur when the place is on the western, or following, limb of the moon. Observers are generally interested only in immersions at the dark limb. As the moon moves more rapidly across the earth's disk than the place is carried eastward by the rotation of the earth, it will overtake and pass the place of observation, and if the place then comes within the radius of the lunar disk while still above the horizon, an occultation is bound to occur. A little practice will enable one to see very readily when and where this will happen.

If H-λ is negative say, for example, $-3^h\,20^m$, an occultation, if it

occurs, must take place *west* of the Y-axis. To find whether there will be an occultation and if so, when, place the lunar disk, which is inscribed at the center of the strip, on the Y-axis at the point Y, with the correct slope, determined by means of the elements x′ and y′. Note also the hourly motion of the moon along its path in centimeters. It will generally be about 57 cm, a little under a millimeter a minute. Note that when the moon's center is at Y on the Y-axis, the place is at the time point $-3^h\ 20^m$ on its ellipse, found by interpolating between the time points $-4^h\ 0^m$ and $-3^h\ 0^m$. The ellipse to be used will be the one corresponding to the star's declination, the position of the ellipse being estimated between those plotted on the chart, if necessary.

If the ellipse in question does not fall within the lunar strip at any point west of the Y-axis, the star can be rejected at this stage as an occultation would clearly be impossible. If it does, however, consider the relative positions of moon and place from the time when the eastern limb of the moon is first in contact with the ellipse along which the place is moving until the moon's center is on the Y-axis. The interval of time that will elapse while the center of the moon is passing along its path from the point at which its limb is first in contact with the ellipse to the point where it crosses the Y-axis, is easily found by measuring the distance between the two points in centimeters along the moon's path and dividing the result by the distance that the moon moves in centimeters per hour. During this same interval of time, which we will call t_0, the place will have moved from a point west of the time point $-3^h\ 20^m$ to that point which will be reached at the time that the moon's center reaches the Y-axis. By means of the intervals between time points on the ellipse it can be estimated where the place was on its ellipse when the moon's eastern limb first came in contact with the ellipse. An occultation could not take place at an earlier point. If H-λ, increased numerically by this time interval, is greater than the star's semi-diurnal arc, which should be known for each ellipse, an occultation is impossible, for the star would then be below the horizon when the moon first came into a position at which a contact of its limb with the ellipse would be possible. If, however, the star is above the horizon and comes within the radius of the lunar disk at some time between the two stellar hour angles H-λ + t_0 and H-λ, where t_0 has the same sign as H-λ, an occultation will occur, and with a little practice one can quickly estimate very closely what the value H-λ + t will be when the immersion occurs. The moon's center and the place on the ellipse should have the same stellar hour angle, H-λ + t, when the edge of the lunar disk is in contact with the place. To find for what value of t this will occur, estimate with the eye the motion of the moon in five or ten minute intervals along its path eastward from the position corresponding to which the eastern edge of the disk is first in contact with the ellipse, noting the motion of the place eastward, along the ellipse, from its corresponding position at that time, in the same intervals of time. An *immersion* will occur when the place is on the eastern limb of the moon, at which time its

stellar hour angle, estimated along the ellipse, will read the same as that of the moon's center. The distance of the moon's center from the Y-axis at that time is measured in centimeters along its path and converted into the time interval t by dividing the distance by the moon's motion in an hour. With practice and care the time of immersion can be estimated within one or two minutes. To find the time of *emersion*, advance the moon's center along its path noting the motion of the place along its ellipse in the same interval of time, and a time will be found when the *western* limb of the moon comes into contact with the place. Find the value of t corresponding to this position as before by measuring the distance of the moon's center from the Y-axis along its path and converting it into a time interval by dividing it by the moon's hourly motion in centimeters. To find the Greenwich Civil Time of the immersion or emersion add T, the Greenwich Civil Time of geocentric conjunction, to the corresponding value of t. The position angle of the point of immersion or emersion is found by drawing a line through the center of the moon's disk parallel to the Y-axis, when it is in the position on the path corresponding to an immersion or emersion, and measuring the angular distance from the north point on the disk to the point of immersion or emersion. To find the position angle from the vertex, or point of the moon's disk directed toward the zenith, draw a line from the point of immersion or emersion to the center of the earth's disk and draw a line from the center of the lunar disk parallel to this line. The angular distance from the point of intersection of this line with the lunar disk to the point of immersion or emersion is the angle of occultation measured from the vertex. To find the altitude of the moon at time of immersion or emersion, measure the distance of the moon's center from the center of the earth's disk at time of the phenomenon. This distance in decimal parts of the earth's radius is the cosine of the altitude of the moon at that time.

If the local hour angle of the moon, H-λ, is positive instead of negative at the time the moon is on the Y-axis, the immersion will take place east of the Y-axis unless the place at that time lies within the radius of the moon's disk, in which case an occultation will be taking place at the time the moon is on the Y-axis. In this case the immersion will take place shortly before the time of geocentric conjunction T. The time of immersion will be determined in the same manner as when H-λ is negative, the value of t to be applied to H-λ to get the hour angle at the time of immersion in this case being small and negative in sign. If H-λ is positive and the place on its ellipse is *outside* of the lunar disk at the time the moon's center is on the Y-axis, there will not be an occultation if the portion of the ellipse along which the place is moving keeps wholly outside of the lunar strip. If, moreover, the value of H-λ is so large that the place will pass off the disk before the moon can overtake it, there can be no occultation. For example, if H-λ is $4^h\,15^m$, the place will be at the point on its ellipse in stellar hour angle $4^h\,15^m$ at the time the moon is on the Y-axis. If now the star's declination is —25°, so

that its semidiurnal arc in latitude 42° 30′ is $4^h\ 28^m$, the place will reach the horizon in 13 minutes and it is evident that in 13 minutes the moon could not move far enough along its path, whatever the value of Y and inclination of its path, to bring its eastern limb in contact with the place. An immersion above the horizon under such circumstances would clearly be impossible. The circumstances under which an occultation will take place when H-λ is positive are readily found in a manner similar to that for negative values of H-λ. Both moon and place are moving eastward, and the immersion will occur when the eastern edge of the lunar disk overtakes the place. The interval, t, that elapsed from the time when the moon left the Y-axis, until its eastern limb came into contact with the place is added to H-λ; t, as before, has the same sign as H-λ, and is applied so as to increase the value of H-λ numerically. Care must be taken to allow for the motion of the place along its ellipse in the interval during which the moon is overtaking it. When the correct value of t has been determined, it is added to T, the time of geocentric conjunction, to obtain the Greenwich Civil Time of immersion, and the time of emersion is obtained similarly.

(To be concluded.)

Planet Notes for June, 1935

By CLIFFORD E. SMITH

NOTE: All times, unless otherwise stated, are Central Standard Time.

The *Sun* will be moving in an easterly direction from the central part of Taurus to the western part of Gemini. Its distance from the earth will increase from about 94.2 to about 94.4 million miles. On June 22 at $2^h\ 38^m$ A.M., the sun will be at the summer solstice which marks, officially, the beginning of summer in the northern hemisphere and of winter in the southern hemisphere. On June 30 there will be a partial eclipse of the sun visible in the northern parts of Europe and Asia. The path will cross part of Scandinavia and the British Isles. The position of the sun on the first and last days of the month will be as follows: R.A. $4^h\ 32^m$, Decl. +21° 54′; and R.A. $6^h\ 32^m$, Decl. +23° 15′.

The phenomena of the *Moon* will occur as follows:

New Moon	June	1	at 2	A.M.
First Quarter		8	" 12	P.M.
Full Moon		16	" 2	P.M.
Last Quarter		23	" 8	A.M.
New Moon		30	" 2	P.M.
Apogee		8	" 3	A.M.
Perigee		20	" 4	A.M.

Mercury will be in western Gemini moving with a slow apparent easterly motion. On the ninth of the month this direction will reverse and Mercury will move over into eastern Taurus. At the beginning of the month it will set about an hour and a half after the sun, but by the end of the month it will be in the morning sky rising about an hour before the sun. Inferior conjunction will occur on June 21 at noon. On the first of the month the distance from the earth to Mercury will be about 68 million miles. This distance will decrease to about 51

million miles on June 20, but will increase to about 56 million miles by the end of the month again. The corresponding change in apparent diameter will be from 9 seconds of arc to 12 seconds of arc and back to 11 seconds of arc again. Mercury will be in conjunction with the moon on June 2 at 8:00 P.M. (Mercury 55′ S), and again on June 29 at 3:00 P.M. (Mercury 7°.0 S). The position of Mercury on the first and last days of the month will be as follows: R.A. $6^h\,7^m$, Decl. +24° 41′, and R.A. $5^h\,42^m$, Decl. +18° 43′.

Venus will be moving in an easterly direction from eastern Gemini, across Cancer to western Leo. It will be an evening object setting about three hours after the sun. Its distance from the earth will decrease from about 87 to about 66 million miles, and its apparent diameter will increase from about 18 to about 24 seconds of arc. It will be in conjunction with the moon on June 4 at 8:00 P.M. (Venus 2°.9). Greatest elongation east will occur on June 30 at 5:00 A.M. (45° 26′).

Mars will be an evening object in central Virgo. During the middle of the month it will set about midnight, local time. Its distance from the earth will increase from about 75 to about 93 million miles, while its apparent diameter will decrease from about 12 to about 9 seconds of arc. Conjunction with the moon will occur at midnight on June 10 (Mars 5°.7 N).

Jupiter will be an evening object in eastern Libra setting about 3:00 A.M., local time, during the middle of the month. Its distance from the earth will be about 425 million miles and its apparent diameter will be about 40 seconds of arc. Conjunction with the moon will occur on June 13 at 6:00 P.M. (Jupiter 6°.2 N).

Saturn will be a morning object in central Aquarius, and, during the first part of the month, it will rise about midnight, local time. Its distance from the earth will be about 880 million miles and its apparent diameter will be about 16 seconds of arc. On June 1 at 1:00 A.M., Saturn will be at quadrature west of the sun, and on June 22 at 1:00 A.M. it will be in conjunction with the moon (Saturn 6°.2 S).

Uranus will be a morning object in southwestern Aries. During the middle of the month it will rise about three hours before the sun. Its distance from the earth will be about 1910 million miles, and its apparent diameter will be about 3⅓ seconds of arc. Conjunction with the moon will occur on June 25 at 10:00 P.M. (Uranus 5°.9 S). Its position on June 15 will be R.A. $2^h\,9^m$, Decl. +12° 28′.

Neptune will continue as an evening object in Leo about two degrees west of χ Leonis. On June 3 at 2:00 A.M., it will be at quadrature east of the sun, and, thus, during this period, it will set about midnight. Conjunction with the moon will occur on June 8 at 5:00 P.M. (Neptune 5°.4 N). Its distance from the earth will be about 2800 million miles, and its apparent diameter will be about 2.4 seconds of arc. Its position on June 15 will be R.A. $10^h\,55^m$, Decl. +7° 58′.

OCCULTATION PREDICTIONS

(Taken from the *American Ephemeris.*)

The quantities in the columns *a* and *b* are given for the purpose of making these predictions useful for any place within 200 miles of the point indicated. The procedure is as follows: Subtract the longitude of the point given from the longitude of the place in question; multiply the result, taking the signs into account, by the quantity under *a* for the star to be observed; similarly, with the latitude, using *b*; apply the sum of the products, with its proper sign, to the Greenwich C.T., and obtain the predicted Greenwich Civil Time for the phe-

nomenon at the place of observation. To obtain Eastern Standard Time it is necessary to subtract five hours; Central Standarrd Time, six hours, etc.

Date 1935		Star	Mag.	IMMERSION Greenwich C.T. h m	IMMERSION *a* m	IMMERSION *b* m	IMMERSION Angle E from N °	EMERSION Greenwich C.T. h m	EMERSION *a* m	EMERSION *b* m	EMERSION Angle E from N °
Occultations Visible in Longitude +72° 30′, Latitude +42° 30′.											
June	6	54 Cnc	6.3	2 45.7	—0.1	—1.1	77	3 30.0	+0.5	—2.0	331
	15	*A* Sco	4.7	0 45.5	—1.0	+0.2	123	2 0.0	—1.8	+0.5	273
	15	3 Sco	5.9	1 14.8	—1.8	+0.9	89	2 30.6	—1.5	—0.3	305
	15	48 B.Sco	5.1	6 43.0	..	..	157	7 12.4	..	..	207
	24	136 B.Psc	6.5	8 21.2	—0.7	+2.0	47	9 30.7	—1.3	+1.4	245
Occultations Visible in Longitude +91° 0′, Latitude +40° 0′.											
June	6	54 Cnc	6.3	2 44.3	—0.4	—1.5	99	3 42.2	+0.2	—2.0	315
	8	155 B.Leo	6.5	4 18.4	—0.8	—0.5	60	4 51.8	+0.3	—3.0	357
	15	*A* Sco	4.7	0 39.7	+0.5	—1.3	162	1 21.3	—2.1	+2.4	237
	15	3 Sco	5.9	0 52.3	—0.6	+0.4	121	2 2.1	—1.4	+0.7	278
	15	48 B.Sco	5.1	6 11.1	—2.0	—2.0	144	7 3.2	—1.2	+0.2	227
	16	118 B.Oph	6.2	7 40.8	—0.7	+0.9	30	8 25.3	—2.2	—2.7	319
	24	136 B.Psc	6.5	8 8.4	—0.1	+2.3	29	9 3.7	—1.1	+1.2	268
	25	101 Psc	6.2	8 51.0	—0.8	+1.3	97	9 40.7	—0.1	+2.5	204
	27	66 Ari	6.1	9 45.5	—0.1	+1.5	75	10 45.0	—0.3	+1.7	244
	27	η Tau	3.0	20 37.4	—1.4	+1.6	26	21 6.1	+0.9	—3.9	330
Occultations Visible in Longitude +120° 0′, Latitude +36° 0′.											
June	8	155 B.Leo	6.5	3 45.9	—1.5	—1.5	109	4 59.8	—0.6	—2.4	321
	10	13 B.Vir	5.8	5 52.7	..	..	199	6 14.8	..	..	227
	16	118 B.Oph	6.2	6 44.0	..	..	29	7 21.7	..	..	338
	17	67 B.Sgr	6.4	11 41.0	—0.6	+0.1	49	12 41.8	—1.0	—1.4	277
	19	σ Cap	5.5	11 36.4	..	..	344	11 54.7	..	..	318
	25	101 Psc	6.2	8 42.2	+0.3	+1.2	80	9 32.7	+0.2	+1.7	229
	27	η Tau	3.0	19 56.5	—1.6	—0.3	76	21 11.3	—1.0	—1.4	275

Variable Stars

Monthly Report of the American Association of Variable Star Observers for March, 1935

The Twenty-fourth Annual Spring Meeting of the Association will be held on May 25 at the Mt. Holyoke College Observatory, South Hadley, Massachusetts.

The first award of the David B. Pickering Nova Medal for the discovery of a nova by visual methods will be made to Mr. J. P. M. Prentice, on June 26, in London at a meeting of the British Astronomical Association when the medal will be presented, in person, to Mr. Prentice by President E. W. Brown.

Secretary Olcott is now sojourning in St. Petersburg, Florida, where he has had the opportunity of visiting once again the splendid Observatory of Rev. T. C. H. Bouton our veteran variable star observer. Mr. Olcott has been lecturing quite extensively during the winter months in Florida.

A very substantial contribution of observations has been made to this report by Dr. J. C. Duncan and his staff of student observers at Wellesley College.

Nova Herculis has begun its rapid drop to minimum after remaining visible to the unaided eye for more than 100 days. On April 2 it had decreased to ap-

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1935.

Jan. 0 = J.D. 2427803; Feb. 0 = J.D. 2427834; Mar. 0 = J.D. 2427862.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
V SCL			R AND			V AND			U TUC			R PSC			R ARI		
000339			001838			004435			*005475*			012502			021024		
799	[13.5	En	838	14.4	L	776	10.7	Bm	858	14.0	Bl	840	14.0	L	865	8.7	Wd
830	[13.3	Bl	865	11.6	Wd	782	9.9	Bm	Z CET			860	[12.7	Pt	870	8.7	Jo
857	11.8	Bl	S TUC			795	9.6	Bm	*010102*			RU AND			871	8.8	Sx
861	11.9	Bl	*001862*			805	9.6	Bm	828	10.5	Sx	013238			W AND		
S SCL			795	[13.2	En	817	9.6	Bm	834	10.8	Fc	830	12.8	Fc	021143a		
001032			806	[13.2	Sl	827	9.6	Bm	836	11.3	Es	837	13.1	L	825	10.5	Ks
795	8.4	En	830	[13.2	Bl	827	10.6	En	U SCL			838	12.7	Wu	830	11.1	Fc
799	8.4	En	858	[13.5	Bl	847	10.1	Jo	*010630*			860	13.5	Pt	860	12.2	Pt
811	9.4	Bl	S CET			861	11.0	Jo	811	10.9	Bl	Y AND			870	[12.0	Gy
827	9.4	En	*001909*			865	11.6	Jo	830	11.3	Bl	013338			T PER		
830	10.3	Bl	826	10.4	Fc	X SCL			836	11.9	Bl	826	10.7	Fc	021258		
836	10.7	Bl	833	10.1	Fc	*004435*			858	12.9	Bl	833	9.9	Fc	836	9.3	Si
848	10.7	Bl	843	10.0	Hi	811	11.2	Bl	U AND			847	9.0	Jo	847	8.7	Jo
855	10.7	Bl	860	9.5	Pt	830	10.6	Bl	010940			860	9.5	Pt	852	8.8	Ra
861	10.6	Bl	861	8.5	Hm	836	10.6	Bl	830	12.0	Fc	861	9.4	Jo	853	9.4	Dl
X AND			862	8.4	Hm	849	11.1	Bl	837	13.2	L	865	9.7	Jo	854	9.3	Dl
001046			T SCL			855	11.2	Bl	UZ AND			865	9.6	Sf	854	8.8	Cl
776	14.7	Bm	*002438a*			861	11.7	Bl	011041			870	9.9	Jo	857	9.1	Sx
782	14.3	Bm	799	10.5	En	RR AND			837	14.5	L	X CAS			860	8.6	Pt
795	13.2	Bm	827	9.0	En	004533			865	11.0	Jo	014958			861	8.5	Jo
805	12.6	Bm	T PHE			755	12.8	Bm	S PSC			843	11.3	Md	861	9.4	Dl
817	11.4	Bm	*002546*			766	13.2	Bm	011208			847	12.0	Jo	862	9.2	Dl
826	10.8	Fc	799	11.9	En	776	13.6	Bm	834	12.0	Fc	860	10.8	Pt	865	9.2	Dl
827	11.3	Bm	811	9.9	Bl	782	14.6	Bm	S CAS			861	11.5	Jo	865	8.6	Jo
833	10.1	Fc	827	9.2	En	795	15.0	Bm	011272			865	11.3	Jo	865	9.1	Wd
847	9.4	Jo	830	9.6	Bl	833	14.2	Fc	826	12.8	Fc	870	11.4	Jo	868	9.2	Dl
861	9.0	Jo	836	9.8	Bl	838	15.0	L	833	12.9	Fc	U PER			870	9.3	Dl
865	8.9	Jo	848	9.7	Bl	RV CAS			834	12.9	Fc	015254			870	8.6	Jo
870	9.2	Jo	855	9.9	Bl	004746a			860	12.3	Pt	830	9.6	Fc	Z CEP		
T AND			861	9.9	Bl	836	14.4	Ar	861	12.5	Jo	836	9.2	Ry	021281		
001726			W SCL			861	[13.9	Pf	861	12.4	Pf	840	9.2	Ry	834	14.4	Ks
820	8.5	Fc	*002833*			— CAS			861	12.5	Ie	843	9.0	Ry	860	[12.5	Pt
833	9.3	Mo	799	12.8	En	004746b			862	12.3	My	848	8.8	Ry	o CET		
843	10.0	Hi	829	13.3	En	836	10.9	Ar	864	11.3	Ra	860	8.7	Ry	*021403*		
847	10.2	Jo	830	13.0	Bl	860	11.2	Pt	865	12.0	Jo	860	8.4	Pt	727	8.0	Bw
852	10.7	Hi	858	13.0	Bl	861	10.8	Pf	870	12.0	Jo	861	7.9	Ba	727	8.0	Bn
860	10.5	Pt	Y CEP			W CAS			875	10.7	My	862	8.8	My	728	8.0	Eo
861	11.8	Jo	003179			004958			U PSC			865	8.6	Ba	728	8.0	Su
861	10.0	Mo	847	9.7	Jo	830	11.5	Fc	011712			870	8.5	Ba	731	9.0	Su
865	12.0	Jo	861	9.7	Jo	847	11.4	Jo	830	11.6	Fc	872	8.8	Sx	731	8.1	Eo
870	12.4	Jo	861	10.0	Gy	850	10.5	Ra	860	[12.3	Pt	875	8.5	My	735	7.9	Eo
T CAS			865	10.0	Gy	860	11.3	Pt	RZ PER			S ARI			735	7.9	Bn
001755			865	10.2	Jo	861	11.2	Jo	012350			015912			735	7.9	Bw
830	11.9	Fc	870	10.8	Jo	862	10.6	My	830	11.9	Fc	826	[15.0	Fc	740	7.8	Eo
847	11.9	Jo	U CAS			865	10.5	Wd	843	11.9	Md	870	[12.3	Gy	743	7.4	Eo
852	11.5	Ra	004047a			865	10.7	Jo	861	12.6	Gy	R ARI			745	7.2	Su
860	12.1	Pt	820	11.9	Fc	870	10.8	Jo	870	12.5	Gy	021024			745	6.7	Eo
861	12.0	Jo	830	13.2	Fc	875	10.1	My	R PSC			825	8.2	Ks	751	6.7	Bn
861	12.0	Gy	861	[13.9	Pf	U TUC			012502			828	8.2	Sx	751	7.5	Su
862	12.0	My	RW AND			*005475*			755	11.4	Bm	847	8.2	Jo	779	4.2	Su
865	11.8	Wd	004132			795	10.3	En	776	12.0	Bm	854	8.5	Ah	781	3.9	Eo
865	12.2	Jo	833	14.3	Fc	799	10.3	En	782	12.3	Bm	857	8.0	Sx	789	3.1	Eo
870	12.3	Jo	838	14.0	L	806	10.7	Sl	796	12.9	Bm	860	8.5	Pt	789	2.9	Bn
870	11.9	Gy	V AND			811	10.9	Bl	805	13.4	Bm	861	8.5	Ah	789	2.9	Bw
R AND			004435			813	11.0	Sl	817	13.4	Bm	861	8.5	Jo	790	2.8	Bn
001838			755	11.4	Bm	827	12.9	En	826	13.9	Fc	864	8.5	Ra	790	2.8	Bw
833	15.0	Fc	766	10.8	Bm	830	12.3	Bl	827	14.2	Bm	865	8.5	Jo	796	3.1	Eo

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1935.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
o CET			o CET			o CET			R CET			R TRI			W PER		
021403			*021403*			*021403*			*022000*			023133			024356		
797	2.2	En	846	3.7	En	865	5.0	Dl	859	7.9	Hi	854	6.0	Ah	854	9.4	Dl
798	2.8	Su	846	3.9	Pm	865	5.2	Hm	859	8.3	Hm	854	5.5	Dl	855	9.6	Mc
799	2.5	En	847	4.3	Hm	865	5.3	Ba	861	8.3	Hm	855	5.6	Hb	856	9.3	Hv
799	2.9	Eo	847	3.7	Jo	865	4.8	Jo	861	8.2	Dl	857	6.0	Sx	857	9.3	Sx
799	2.9	Bn	847	4.0	Pm	868	5.1	Dl	861	7.8	Jo	859	5.4	Dl	859	9.3	Dl
799	2.8	Bw	848	4.0	Si	868	5.6	Hm	862	7.9	My	860	6.0	Pt	859	9.4	Wh
800	2.7	En	849	4.0	Pm	870	5.4	Hm	862	8.3	Dl	861	5.8	Gy	860	9.1	Ry
802	2.7	En	850	4.1	Hv	870	5.0	Jo	862	8.4	Hm	861	6.1	Ah	860	9.1	Pt
802	2.8	Eo	851	4.5	Hm	870	4.9	Ra	865	8.3	Hm	861	6.4	Jo	861	9.4	Jo
802	2.8	Bn	852	4.4	Hm	871	5.0	Sx	865	8.7	Dl	861	5.4	Dl	861	9.3	Dl
802	2.7	Bw	852	4.1	Pm	871	5.4	Hm	865	7.7	Jo	861	5.9	Hm	861	9.3	Hm
803	2.5	En	852	3.9	Bu	S PER			870	8.0	Jo	862	5.8	Hm	862	9.2	Hm
803	2.8	Bw	853	4.1	Hv	021558			870	8.5	Hm	862	5.4	Dl	862	9.3	Dl
805	2.8	Eo	853	4.2	Dl	825	8.7	Ks	RR PER			864	6.5	Sf	862	9.6	My
806	2.7	En	853	4.5	Hm	834	9.0	Ks	022150			865	6.1	Hm	863	9.7	Cy
806	2.6	Fs	854	4.2	Hm	836	9.3	Af	825	9.4	Ks	865	5.4	Dl	865	9.4	Dl
806	2.8	Su	854	4.3	Dl	836	9.4	Dh	830	10.0	Fc	865	6.0	Jo	865	9.4	Hm
807	2.8	En	854	4.3	Si	836	9.3	Fr	834	9.9	Ks	865	5.8	Wd	865	9.3	Jo
807	3.0	Eo	854	4.1	Fn	836	8.8	Si	860	10.7	Pt	868	6.2	Hm	868	9.3	Dl
808	2.7	En	854	4.5	Sf	838	9.2	Fs	864	11.1	Ra	868	5.5	Dl	870	9.4	Dl
808	2.9	Bn	854	4.9	Ah	847	9.0	Jo	R FOR			870	5.4	Dl	870	9.3	Hm
808	2.9	Bw	854	4.2	Hv	852	9.6	Ra	*022426*			870	6.0	Gy	870	9.4	Jo
810	2.8	En	854	4.0	Fr	853	9.6	Dl	811	12.4	Bl	870	5.8	Hm	871	9.4	Dl
811	2.8	En	855	3.8	Mc	854	9.6	Dl	827	12.1	Fc	870	5.8	Jo	871	9.3	Sx
814	3.0	Bn	855	4.1	Pm	854	9.0	Cl	830	12.0	Bl	870	5.9	Ra	875	9.0	My
814	3.0	Bw	855	4.6	Ra	857	9.4	Sx	836	11.4	Bl	871	6.3	Sx	R HOR		
815	2.9	En	855	4.2	Hm	859	9.6	Dl	849	11.5	Bl	T ARI			*025050*		
815	3.0	Su	855	4.1	Hb	860	8.9	Pt	855	11.2	Bl	024217			795	10.3	En
818	2.9	En	856	4.2	Hv	861	9.4	Dl	861	11.3	Bl	825	8.7	Ks	799	10.6	En
818	3.2	Bw	856	4.0	Pb	861	9.5	Gy	U CET			828	9.1	Sx	806	10.1	Sl
819	2.9	En	857	4.5	Hv	861	9.3	Jo	*022813*			836	8.6	Hu	811	10.8	Bl
821	3.3	Bw	857	4.0	Pb	862	9.3	Dl	836	8.6	Fn	836	8.8	Si	813	10.5	Sl
825	3.1	En	857	4.2	Pm	862	9.3	My	861	7.8	Jo	847	9.2	Jo	827	11.2	En
826	3.1	En	857	4.7	Sx	862	9.2	Fs	861	8.1	Hm	854	8.4	Hu	830	11.3	Bl
827	3.1	En	858	4.4	Hk	863	9.2	Cy	865	8.0	Hm	857	8.7	Sx	836	11.8	Bl
827	3.7	Sx	859	4.3	Dl	864	9.2	Cy	865	7.8	Jo	861	8.7	Jo	844	12.2	En
828	3.2	En	859	4.4	Hm	865	9.3	Jo	868	8.2	Hm	865	8.6	Jo	849	12.0	Bl
829	3.3	En	860	3.8	Ar	865	9.3	Dl	870	8.1	Hm	870	8.6	Jo	855	12.1	Bl
830	3.4	Gy	860	3.8	Lf	865	9.5	Wd	RR CEP			871	8.9	Sx	861	12.4	Bl
831	3.4	En	860	3.8	Dh	868	9.3	Dl	022980			W PER			T HOR		
835	3.1	Pb	860	4.8	Hv	870	9.4	Dl	825	12.6	Ks	024356			*025751*		
835	3.5	En	860	3.8	Pb	870	9.4	Gy	834	12.0	Ks	825	8.9	Ks	799	10.6	En
836	4.0	Dh	860	4.3	Bu	870	8.9	Jo	834	12.1	Fc	828	9.2	Sx	806	9.7	Sl
836	3.6	Fn	860	5.3	Pt	871	9.3	Sx	860	10.7	Pt	834	8.7	Ks	811	9.7	Bl
836	3.5	En	861	4.8	Dl	875	9.3	My	870	9.9	Ie	836	9.8	Hu	813	9.3	Sl
836	3.9	Hu	861	4.4	Hm	R CET			871	9.9	Ra	836	10.3	Af	827	9.3	En
836	3.7	Pm	861	4.6	Ba	*022000*			R TRI			836	10.5	Dh	830	9.0	Bl
836	3.8	Si	861	5.1	Ah	827	8.0	Fc	023133			836	10.4	Fr	836	8.2	Bl
837	4.0	Dh	861	4.5	Jo	830	8.0	Fc	825	7.2	Ks	836	9.1	Ry	849	8.2	Bl
837	3.8	Fr	861	3.9	Pb	836	7.8	Fn	828	7.3	Sx	840	9.3	Jo	855	8.6	Bl
840	3.5	En	861	4.3	Pm	843	7.8	Hi	836	6.4	Hu	841	9.1	Ry	861	8.4	Bl
840	4.3	Ah	862	4.8	Dl	847	7.8	Jo	836	6.0	Fr	843	9.1	Ry	U ARI		
840	3.6	Hh	862	4.7	Hm	852	7.9	Ra	836	5.9	Af	848	9.2	Ry	030514		
841	3.5	En	862	4.7	Si	852	7.8	Hi	836	6.8	Si	850	9.5	Ra	755	12.6	Bm
842	3.5	En	862	4.4	Pm	853	8.2	Dl	852	5.6	Ra	853	9.3	Dl	783	13.6	Bm
843	3.6	En	863	4.5	Cy	853	8.2	Hm	853	5.3	Dl	853	9.4	Hb	796	14.0	Bm
844	3.6	En	863	4.8	Hm	854	8.2	Hm	853	6.5	Hm	854	9.4	Hv	826	15.2	Fc
845	3.6	En	864	4.7	Dl	854	8.1	Dl	854	5.6	Hm	854	9.9	Fr	827	14.9	Bm

Variable Star Observations Received During March, 1935.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
U Ari			U Cam			R Tau			RX Tau			R Cae			R Lep		
030514			033362			042209			043208			*043738*			*045514*		
870	13.1	Gy	847	7.8	Jo	860	10.4	Pt	861	10.6	Jo	862	9.8	Bl	855	9.5	Hb
X Cet			861	7.8	Jo	861	9.8	Gy	863	9.6	Es	ST Cam			856	8.9	Mg
031401			862	7.8	Si	861	9.4	Jo	864	9.9	Sf	044067			856	8.8	Mb
827	12.3	Fc	863	8.2	Cy	863	9.8	Cy	865	10.4	Jo	834	6.8	Ks	857	9.5	Pb
852	12.4	Ra	864	8.1	Cy	865	9.8	Jo	870	10.4	Jo	RV Tau			857	9.3	Sx
860	11.4	Pt	865	7.7	Jo	870	9.9	Gy	R Ret			044126			857	8.3	Sq
861	11.4	Ba	865	8.2	Hm	870	10.0	Jo	*043263*			810	10.1	Ks	858	8.5	Hh
861	10.6	Jo	870	8.0	Hm	871	9.9	Sx	795	9.0	En	826	10.1	Ks	860	9.5	Je
862	11.5	My	870	7.6	Jo	W Tau			799	9.3	En	834	10.4	Ks	860	9.6	Pb
865	10.4	Jo	871	8.1	Cy	042215			803	9.5	En	R Pic			860	7.5	Pt
865	11.2	Ba	U Eri			836	11.3	Af	806	8.8	Sl	*044349*			861	9.4	Gy
870	11.5	Gy	*034625*			836	11.5	Dh	807	9.6	En	803	7.9	En	861	9.4	Kp
870	10.6	Jo	829	11.4	En	836	11.3	Dh	811	9.0	Bl	807	7.7	En	861	8.0	Jo
Y Per			X Per			836	11.6	Dh	813	9.0	Sl	811	7.6	Bl	861	9.5	Pb
032043			034930			836	11.2	Fr	829	10.3	En	829	7.5	En	861	9.3	Rc
825	8.2	Ks	855	6.6	Mc	836	11.1	Hu	830	10.0	Bl	833	7.9	Bl	861	9.4	Dl
828	9.0	Sx	859	6.3	Mc	837	11.2	Fr	836	9.9	Bl	836	7.7	Bl	861	9.3	Hm
834	8.2	Ks	869	6.3	Mc	843	11.1	Es	842	11.0	En	842	7.3	En	862	9.3	Hm
836	9.0	Af	T Eri			845	11.3	Hu	849	10.9	Bl	849	7.8	Bl	862	9.5	Dl
836	8.8	Fr	*035124*			854	11.4	Fr	855	11.1	Bl	855	7.7	Bl	862	9.3	Kp
852	9.1	Ra	829	12.2	En	856	11.5	Ar	862	11.4	Bl	862	7.5	Bl	865	8.4	Jo
853	9.0	Ah	W Eri			856	11.3	Hu	X Cam			V Tau			865	9.5	Dl
854	9.0	Hv	*040725*			860	11.2	Hu	043274			044617			865	9.4	Hm
855	8.6	Mc	831	9.8	Fc	860	11.2	Pt	834	9.0	Ks	856	11.0	Mg	865	8.9	Wd
856	9.1	Hv	862	8.8	Si	861	11.0	Ba	860	10.0	Pt	856	10.8	Mb	866	9.4	Rc
857	9.0	Hv	T Tau			861	10.5	Jo	861	9.5	Jo	861	12.0	Gy	868	9.5	Dl
857	8.3	Sx	041619			862	11.7	My	862	10.1	My	870	12.6	Gy	870	9.5	Gy
857	8.7	Hb	748	10.4	Bm	863	11.4	Cy	863	10.1	Cy	871	12.7	Ie	870	8.2	Jo
858	9.0	Ah	771	10.7	Bm	865	11.0	Wd	865	9.7	Jo	R Ori			870	9.5	Ra
860	8.0	Pt	783	10.2	Bm	865	11.1	Ba	870	10.3	Jo	045307			870	9.6	Hm
861	8.5	Wh	796	10.0	Bm	865	10.6	Jo	875	11.1	My	836	9.5	Af	871	9.5	Sx
861	9.2	Ah	805	10.0	Bm	870	10.8	Jo	R Dor			836	9.5	Fr	W Ori		
861	9.0	Jo	817	9.8	Bm	870	11.0	Ba	*043562*			842	10.0	Md	050001		
865	8.9	Jo	826	10.3	Bm	875	10.8	My	795	5.5	En	861	9.5	Jo	834	6.2	Ks
870	9.0	Jo	826	10.2	Ks	S Tau			799	5.5	En	863	10.1	Es	847	6.5	Jo
871	9.3	Sx	R Tau			042309			803	5.5	En	863	9.9	Cy	870	6.1	Jo
R Per			042209			748	12.2	Bm	806	5.2	Sl	864	10.1	Sf	V Ori		
032335			748	13.0	Bm	771	13.5	Bm	807	5.5	En	865	9.7	Jo	050003		
835	13.3	Wu	771	12.2	Bm	783	13.6	Bm	811	5.8	Bl	870	10.0	Jo	771	13.4	Bm
852	12.1	Ra	783	11.2	Bm	796	13.8	Bm	813	5.2	Sl	R Lep			796	11.8	Bm
857	11.0	Sx	796	10.4	Bm	805	14.1	Bm	829	5.5	En	*045514*			817	10.4	Bm
860	11.0	Pt	805	10.3	Bm	826	14.6	Bm	830	5.5	Bl	806	6.8	Sl	826	10.8	Bm
861	10.9	Jo	817	8.8	Bm	826	14.0	Ks	836	6.0	Bl	813	6.9	Sl	840	10.9	Br
861	10.8	Cl	826	9.3	Bm	826	14.5	Fc	842	5.5	En	828	9.0	Sx	852	9.5	Ra
862	10.6	My	826	8.1	Ks	827	14.5	Fc	849	6.1	Bl	828	8.7	Rc	854	9.2	Cl
865	10.7	Jo	826	8.2	Fc	833	14.5	Fc	855	6.0	Bl	835	9.4	Pb	860	9.4	Pt
870	10.4	Jo	827	8.2	Fc	836	14.3	Ar	862	5.7	Bl	836	7.9	Si	861	9.0	Jo
875	9.9	My	833	8.4	Fc	870	12.8	Gy	R Cae			837	8.9	Rc	865	9.0	Jo
Nov Per			835	8.5	Es	T Cam			*043738*			838	9.2	Fs	870	9.0	Jo
032443			836	9.0	Hu	043065			803	7.4	En	840	8.3	Hh	T Lep		
836	12.5	Ar	836	9.0	Ar	834	10.2	Ks	807	8.8	En	847	7.7	Jo	*050022*		
837	12.9	Ar	837	7.9	Fr	860	12.0	Pt	811	8.4	Bl	850	8.8	Ra	748	11.9	Bm
860	12.8	Pt	838	8.6	L	871	11.7	Ra	829	8.8	En	853	9.0	Kp	771	11.7	Bm
870	12.8	Gy	843	9.2	Es	RX Tau			833	9.0	Bl	853	9.3	Dl	796	10.6	Bm
U Cam			852	9.5	Ra	043208			836	8.9	Bl	854	9.2	Kp	811	9.2	Bl
033362			856	9.3	Es	835	10.3	Es	842	9.2	En	854	9.2	Hm	817	9.0	Bm
834	7.7	Ks	857	9.7	Sx	843	10.3	Es	849	9.1	Bl	854	9.4	Dl	826	8.4	Bm
838	7.6	Si	858	9.4	Hi	860	10.0	Pt	855	9.7	Bl	855	9.2	Rc	828	8.6	Fc

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1935.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
T LEP			S AUR			S ORI			T ORI			AN ORI			RR TAU		
050022			052034			*052404*			*053005a*			*053005t*			053326		
829	8.4	En	854	10.7	Wd	862	10.2	Hm	858	10.6	Wa	860	11.6	Hk	861	11.6	Bs
829	8.4	Wh	858	11.0	Gy	862	10.3	Dl	859	10.0	Pt	860	11.5	Lf	863	11.5	Cy
833	8.1	Bl	860	9.6	Pt	863	10.0	Es	859	10.1	Hf	860	11.5	Ar	864	12.5	Cy
844	8.4	En	861	11.6	Gy	863	10.3	Hm	860	10.2	Lf	860	11.7	Hu	864	12.2	Wp
847	8.0	Jo	861	11.0	Ba	864	10.2	Dl	860	10.3	Ar	860	11.6	Pb	864	12.2	Wa
849	8.0	Bl	861	10.4	Dl	865	10.2	Dl	860	10.1	Pt	861	11.7	Pb	865	12.2	Wp
855	8.2	Bl	865	10.5	Ba	865	10.2	Hm	860	10.3	Hu	865	11.6	Wd	865	12.3	Rb
860	8.7	Pt	868	10.4	Dl	865	9.9	Jo	860	10.4	Hk	870	11.6	Ra	865	12.3	Gy
861	8.4	Jo	870	10.4	Dl	865	10.2	Wd	860	10.4	Pb	870	11.5	Cm	865	12.3	Wa
862	8.2	Bl	870	9.9	Jo	868	10.3	Dl	860	10.2	Dh	870	11.5	Wd	871	13.3	Wp
865	8.6	Jo	870	11.0	Gy	870	10.1	Gy	861	10.6	Pb	871	11.7	Kg	871	13.2	Wa
865	8.7	Wd	875	11.0	My	870	10.0	Jo	861	10.8	Jo	S CAM			871	13.2	Cy
870	8.8	Jo	W AUR			870	10.0	Wd	861	10.9	Bs	053068			RU AUR		
S PIC			052036			970	10.4	Dl	861	11.0	Rb	861	9.5	Pt	053337		
050848			828	10.2	Sx	870	10.0	Sh	861	10.3	Pt	862	8.8	My	861	12.0	Pt
807	12.0	En	833	10.4	Mo	871	10.0	Kg	862	10.4	Hf	862	8.9	Si	U AUR		
811	12.2	Bl	835	10.6	Hi	T ORI			862	10.8	My	864	9.2	Ra	053531		
829	12.5	En	836	10.2	Af	*053005a*			863	10.6	Cy	865	8.5	Jo	840	13.6	Br
833	12.5	Bl	836	10.1	Fr	835	10.4	Pb	863	10.9	Es	870	8.4	Jo	870	13.7	Ie
842	12.9	En	837	10.3	Fn	836	10.5	Lf	864	11.1	Cy	875	8.7	My	Y TAU		
858	13.5	Bl	850	11.2	Ra	836	10.9	Hu	865	10.7	Hf	RR TAU			053920		
R AUR			854	11.6	Wd	836	10.7	Ar	865	10.5	Wd	053326			810	7.2	Ks
050953			858	11.6	Hi	836	10.6	Af	865	11.0	Jo	748	11.6	Bm	826	7.0	Ks
831	14.4	Fc	860	11.9	Pt	836	10.7	Fr	868	9.9	Cm	760	11.6	Bm	834	6.9	Ks
833	13.4	Ks	861	11.9	Fn	836	10.6	Hk	869	10.6	Pt	771	11.4	Bm	SU TAU		
852	12.6	Ra	865	11.5	Fa	836	10.7	Dh	870	9.9	Sh	796	10.7	Bm	054319		
860	12.9	Pt	870	12.0	Fa	837	10.9	Ar	870	9.5	Ra	810	12.0	Ks	810	9.7	Ks
T PIC			871	12.1	Ie	837	11.0	Fr	870	10.5	Jo	813	11.3	Br	813	9.6	Br
051247			S ORI			840	11.7	Be	870	10.0	Cm	826	12.2	Ks	828	10.1	Fc
807	8.8	En	*052404*			841	10.8	Hf	870	10.1	Wd	826	12.3	Bm	834	9.6	Ks
811	8.5	Bl	828	9.9	Sx	844	10.7	Hf	871	10.3	Kg	828	11.4	Fc	836	9.9	Ar
829	8.1	En	836	9.9	Dh	845	10.9	Hf	871	10.6	Sx	830	11.4	Fc	837	9.9	Ar
833	8.2	Bl	836	9.9	Af	846	10.6	Hf	871	10.1	Cy	834	11.1	Ks	838	9.9	Si
842	8.4	En	836	10.0	Fr	847	11.0	Jo	875	10.4	My	836	10.9	Ry	840	9.9	Br
849	8.4	Bl	836	9.6	Fn	849	10.4	Be	AN ORI			836	11.4	Ar	841	10.0	Hf
855	8.6	Bl	836	10.0	Hu	849	10.4	Hf	*053005t*			837	11.4	Ar	844	9.9	Hf
862	8.9	Bl	837	10.1	Fr	850	10.0	Ra	835	11.6	Pb	840	10.7	Br	845	9.9	Hf
NOV TAU			840	9.6	Br	853	10.2	Hf	836	11.4	Hu	840	10.9	Ry	846	9.9	Hf
051316			847	9.7	Jo	853	10.2	B	836	12.0	Ar	841	10.9	Ry	849	9.6	Be
836	14.8	Ar	848	10.0	Fn	853	10.2	Wp	836	11.6	Lf	842	10.9	Ry	849	9.7	Hf
837	14.5	Ar	850	10.0	Ra	853	10.2	Wa	836	11.7	Hk	843	10.7	Ry	852	9.8	Wa
T COL			853	10.2	Dl	854	10.3	Hf	836	11.8	Dh	849	11.1	Be	852	9.9	Wp
051533			854	10.1	Fr	854	10.0	Pt	837	12.0	Ar	852	11.0	Wa	853	9.6	Hf
807	11.7	En	854	10.4	Cl	854	10.5	Hu	850	11.3	Ra	852	11.0	Wp	853	9.6	Wp
811	11.7	Bl	854	10.2	Dl	854	10.5	Fr	853	11.3	Wa	853	10.9	Wp	853	9.7	Wa
829	12.1	En	854	9.9	Wd	854	10.2	Ar	853	11.4	Wp	853	11.0	Wa	854	9.7	Hf
833	12.2	Bl	856	10.1	Dh	854	10.4	Wd	854	11.6	Wd	856	11.7	Ar	854	9.9	Pt
842	12.2	En	856	10.0	Hu	855	10.2	Hf	854	11.6	Hf	856	11.7	Dh	854	9.7	Wd
849	11.4	Bl	856	9.9	Mg	855	10.5	Hu	854	11.6	Ar	857	11.0	Wp	855	9.7	Hf
856	11.1	Bl	856	10.0	Mb	856	10.4	Dh	856	11.5	Lf	857	11.2	Wa	856	9.9	Ar
862	10.8	Bl	857	10.5	Wh	856	10.3	Lf	856	11.6	Hu	858	11.9	Br	856	9.8	Hu
S AUR			859	10.2	Dl	856	10.3	Ar	856	11.6	Dh	858	11.8	Wp	857	9.4	Wa
052034			860	10.0	Hu	856	10.3	Hu	856	11.6	Pb	858	11.8	Wa	857	9.3	Wp
828	10.7	Sx	860	9.8	Pt	856	10.3	Pb	856	11.6	Ar	858	11.8	Gy	858	9.5	Wa
836	10.7	Af	861	10.1	Fn	857	10.2	Pb	857	11.8	Pb	860	12.2	Ar	858	9.7	Br
836	11.0	Fr	861	9.9	Jo	857	9.9	Bj	858	11.8	Wp	860	12.2	Dh	858	9.4	Bj
837	10.7	Fr	861	10.2	Dl	857	9.8	Sx	858	11.6	Wa	860	11.6	Ry	858	9.4	Wp
850	10.5	Ra	861	10.2	Hm	858	10.4	Wp	860	11.6	Dh	861	11.8	Gy	859	9.7	Pt

Variable Star Observations Received During March, 1935.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
SU Tau			R Col			U Ori			R Oct			Nov Pic			V CMi		
054319			*054629*			054920a			*055686*			*063462*			070109		
859	9.6	Hf	833	13.0	Bl	860	8.3	Je	849	9.8	Bl	807	9.0	En	828	12.6	Fc
860	9.9	Pt	842	12.5	En	860	8.4	Hu	856	9.8	Bl	827	9.0	En	858	13.8	Br
860	9.9	Ar	858	12.7	Bl	860	7.9	Bu	862	10.1	Bl	843	9.0	En	861	13.7	Pt
861	9.8	Ie	862	12.6	Bl	861	7.8	Ah	X Aur			S Lyn			870	13.5	Gy
861	9.6	Gy	α Ori			861	8.1	Je	060450			063558			R Gem		
861	9.6	Pt	*054907*			861	8.0	Kp	827	11.3	Fc	828	12.3	Fc	070122a		
862	9.5	Si	806	1.1	Sl	861	7.8	Jo	831	10.6	Fc	833	12.5	Ks	828	6.9	Sx
862	9.7	Hf	813	1.1	Sl	861	8.6	Rc	840	9.2	Mx	840	12.8	Ry	838	7.7	Fs
863	9.8	Cy	836	0.6	Si	861	7.8	Dl	842	9.8	Md	843	13.2	Ry	840	6.5	Hh
864	9.5	Wa	851	0.9	Hm	861	7.9	Hm	850	9.1	Ra	858	13.5	Br	844	6.9	Ah
864	9.7	Wp	852	0.8	Hm	861	7.5	Pt	857	10.1	Sq	860	13.5	Ry	847	7.0	Jo
864	9.8	Cy	853	0.9	Hm	862	7.9	Si	861	8.5	Pt	X Gem			853	7.5	Ah
865	9.7	Hf	853	0.9	Dl	862	8.2	Je	861	8.7	Fa	064030			854	7.0	Wd
865	9.3	Gy	854	0.9	Dl	862	8.4	Fs	865	8.5	Fa	827	12.4	Fc	857	7.5	Ra
865	9.5	Wp	854	0.4	Si	862	8.0	Kp	870	9.0	Fa	831	12.1	Fc	857	7.5	Sx
865	9.5	Rb	854	1.0	Hm	862	8.7	Dl	V Aur			857	11.3	Ra	858	7.1	Hh
865	9.4	Wa	861	1.0	Hm	862	7.9	Hm	061647			858	11.4	Br	858	7.5	Ah
869	9.5	Pt	861	0.8	Dl	865	7.7	Jo	815	11.5	Gy	863	11.3	Cy	860	7.7	Je
870	9.7	Gy	862	0.8	Dl	865	8.5	Kg	827	10.2	Fc	863	11.6	Wd	860	7.7	Bu
871	9.4	Wp	862	0.9	Hm	865	8.1	Hm	831	10.2	Fc	866	11.0	Sx	861	7.8	Hm
871	9.7	Pt	865	0.8	Hm	865	8.8	Dl	842	10.5	Md	870	10.6	Gy	861	7.5	Je
871	9.3	Wa	870	0.7	Dl	866	8.6	Rc	858	10.5	Gy	871	10.7	Ra	861	7.0	Pt
871	9.3	Cy	870	0.8	Hm	868	8.8	Dl	861	11.0	Fn	Y Mon			862	7.1	Si
S Col			U Ori			868	8.0	Hm	865	10.2	Fa	065111			862	8.0	Hg
054331			054920a			869	8.6	Mc	870	10.0	Fa	828	13.5	Fc	862	7.6	Ah
809	11.6	En	827	6.8	Sx	870	8.0	Jo	870	9.9	Gy	836	13.6	Hk	862	7.7	Je
811	11.8	Bl	828	6.7	Rc	870	8.6	Ra	V Mon			861	12.8	Pt	862	7.6	Fs
829	10.2	En	834	6.5	Ks	870	8.4	Hm	*061702*			X Mon			863	7.3	Es
833	9.7	Bl	836	7.3	Af	870	9.0	Dl	836	8.9	Hk	*065208*			870	8.4	Sh
842	9.7	En	836	7.3	Fr	870	8.8	Sx	836	9.3	Si	828	8.3	Sx	870	7.4	Ra
849	9.2	Bl	837	6.6	Fn	870	8.6	Gy	840	8.4	Br	836	8.2	Hk	870	7.5	Sx
856	9.2	Bl	837	7.0	Rc	V Cam			854	8.4	Kp	837	8.6	Si	Z Gem		
862	9.1	Bl	837	6.5	Si	054974			856	7.3	Sq	840	8.2	Mx	070122b		
Z Tau			838	8.3	Fs	831	13.9	Fc	858	7.8	Mx	853	8.0	Hb	854	12.4	Wd
054615a			839	6.4	Sq	840	13.6	Br	860	7.2	Je	857	7.4	Ra	857	12.6	Ra
748	12.9	Bm	840	8.0	Hh	871	12.5	Ra	861	7.2	Je	858	8.0	Mx	863	12.4	Es
760	14.0	Bm	843	7.2	Es	Z Aur			861	7.9	Kp	859	7.9	Sx	870	12.6	Ra
771	13.6	Bm	844	7.3	Ah	055353			861	7.2	Jo	860	7.5	Mx	TW Gem		
796	14.0	Bm	850	7.9	Ra	828	10.4	Fc	861	7.1	Pt	861	7.7	Jo	070122c		
840	13.6	Br	851	7.3	Hm	836	10.6	Hk	862	7.3	Je	865	7.5	Jo	828	8.5	Sx
870	12.6	Gy	852	7.5	Hm	836	10.6	Fr	862	7.6	Kp	867	7.5	Mx	854	8.3	Wd
RS Tau			853	8.0	Cl	836	10.6	Af	865	7.4	Jo	870	7.6	Gy	857	8.7	Sx
054615b			853	7.7	Ah	854	10.4	Wd	869	7.8	Mx	870	7.6	Jo	857	8.4	Ra
826	9.1	Fc	853	7.8	Hg	854	10.4	Pt	870	7.2	Jo	871	7.4	Sx	861	8.1	Pt
861	9.2	Gy	853	7.5	Kp	861	10.5	Fa	872	7.2	Sx	R Lyn			862	8.3	Si
870	9.4	Gy	853	7.7	Hm	861	10.9	Gy	U Lyn			065355			863	8.4	Es
RU Tau			853	7.0	Hb	863	10.9	Cy	063159			820	9.0	Ks	870	8.4	Ra
054615c			854	8.1	Wd	865	10.8	Fa	831	13.1	Fc	840	9.2	Hh	870	8.5	Sx
748	10.8	Bm	854	7.7	Kp	865	11.2	Gy	858	13.2	Br	857	11.0	Ra	870	8.5	Sh
760	10.8	Bm	854	7.6	Dl	870	10.8	Gy	R Mon			RS Gem			R CMi		
771	11.3	Bm	854	7.9	Hm	870	10.8	Fa	063308			065530			070310		
796	12.2	Bm	855	7.5	Sq	871	11.2	Cy	836	12.8	Ar	865	11.2	Gy	820	8.4	Fc
840	13.9	Br	855	8.4	Rc	R Oct			842	11.8	Md	870	12.1	Gy	820	8.0	Ks
870	12.6	Gy	857	8.0	Cl	*055686*			856	12.4	Ar	Z CMa			828	8.5	Sx
R Col			857	8.6	Sx	807	6.5	En	856	12.3	Dh	*065911*			838	8.2	Si
054629			858	7.8	Ah	811	7.2	Bl	860	11.9	Ar	806	10.3	Sl	847	7.8	Jo
803	12.5	En	858	8.8	Hh	833	9.1	Bl	860	11.9	Dh	813	10.3	Sl	850	8.3	Ra
826	13.5	Fc	859	7.7	Mc	835	8.0	En	863	12.5	Es				853	8.3	Ah

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1935.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
R CMi			X Pup			T Gem			X UMa			RW Car			RR Hya		
070310			*072820a*			074323			083350			*091868*			*094023*		
857	8.0	Sq	862	9.0	Si	871	13.5	Kg	861[	12.5	Pt	858[	12.8	Bl	786	12.3	Bm
858	8.0	Ah	Z Pup			U Pup			S Hya			Y Vel			798	11.8	Bm
859	8.4	Sx	*072820b*			*075612*			084803			*092551*			811	12.0	Bm
860	8.2	Hk	748	14.0	Bm	836[	12.5	Hk	820	8.0	Fc	811[	12.9	En	821	11.4	Bm
861	8.0	Pt	761	12.8	Bm	RV Cnc			826	8.0	Ks	858	13.3	Bl	835	10.4	En
870	8.2	Gy	771	11.3	Bm	080319			828	8.0	Fc	862	13.5	Bl	875	9.0	My
871	8.4	Sx	779	10.0	Bm	840	12.0	Br	853	8.2	Ah	R Car			R Leo		
R Vol			786	8.8	Bm	858	11.9	Br	857	8.0	Ra	*092062*			094211		
070772			798	8.5	Bm	SU UMa			858	8.4	Ah	794	4.2	En	773	7.0	Pg
809	12.6	En	811	8.2	Bm	080362			860	8.1	Cl	799	4.7	En	836	9.5	Dh
829	13.0	En	820	7.9	Fc	813[	14.0	Br	861	8.1	Fn	800	4.7	En	836	9.6	Fr
L_2 Pup			828	8.5	Fc	858	11.6	Br	861	8.0	Jo	802	4.7	En	838	10.0	Si
071044			860	9.7	Hk	R Cnc			861	8.2	Pt	806	4.6	Sl	844	9.3	Ah
806	4.2	Sl	861	9.8	Gy	081112			862	8.5	Ah	811	4.7	En	853	9.3	Ah
813	4.1	Sl	862	9.3	Si	826	9.9	Ks	X Cnc			811	4.7	Bl	854	10.1	Kp
862	4.9	Si	865	10.1	Gy	833	10.0	Ks	084917			813	4.8	Sl	854	10.2	Dl
RR Mon			867	9.8	Rc	836	10.3	Hk	826	6.2	Ks	827	4.9	En	854	9.9	Hm
071201			870	10.0	Gy	839	10.1	Sq	T Hya			833	5.5	Bl	854	9.8	Wd
831	14.6	Fc	S Vol			857	10.2	Ra	*085008*			835	5.1	En	855	10.1	Sq
836	15.0	Ar	*073173*			859	9.4	Hi	820	7.9	Fc	843	5.7	En	855	9.0	Pg
V Gem			809	12.8	En	861	9.6	Jo	857	9.3	Ra	849	5.9	Bl	855	9.7	Mc
071713			829	12.8	En	861	9.6	Je	861	9.8	Pt	856	6.7	Bl	857	9.8	Dt
820	8.3	Fc	833	13.5	Bl	861	9.5	Pt	864	9.9	Cy	862	6.6	Bl	857	10.0	Sx
861	11.4	Pt	858[	13.2	Bl	865	8.7	Hm	871	9.9	Cy	X Hya			858	9.3	Ah
S CMi			U CMi			866	9.8	Sx	T Cnc			*093014*			859	9.4	Mc
072708			073508			870	8.6	Hm	085120			748	12.4	Bm	859	10.3	Dl
820	9.5	Ks	860	10.5	Hk	871	9.2	Sf	836	10.3	Hk	761	12.5	Bm	861	10.5	Ba
828	9.2	Sx	861	9.7	Pt	V Cnc			861	8.9	Jo	771	12.6	Bm	861	10.0	Je
838	8.8	Si	863	10.5	Cy	081617			861	9.2	Pt	779	12.4	Bm	861	10.3	Kp
850	8.7	Ra	871	10.1	Cy	826	11.2	Ks	S Pyx			786	12.4	Bm	861	9.5	Jo
853	8.6	Dl	S Gem			828	12.1	Fc	*090024*			798	11.6	Bm	861	10.0	Hm
854	8.6	Dl	073723			836	12.2	Hk	748	11.3	Bm	811	10.8	Bm	861	10.2	Dl
855	8.5	Pg	820	10.1	Fc	870	12.9	Gy	761	12.2	Bm	820	10.0	Fc	861	8.6	Pt
857	8.3	Wh	820	9.9	Ks	RT Hya			771	12.8	Bm	821	10.3	Bm	862	9.8	Bk
859	8.6	Sx	826	10.0	Ks	*082405*			779	13.8	Bm	828	9.9	Fc	862	10.2	Dl
859	8.5	Dl	828	11.1	Fc	820	8.0	Fc	821[	11.6	Bm	836	10.0	Fn	862	9.9	Hm
860	8.4	Hk	854	12.2	Wd	836	8.4	Hk	860	11.4	Hk	838	10.0	Si	862	10.2	Kp
861	8.6	Dl	858	12.6	Br	861	8.6	Jo	T Pyx			855	9.5	Pg	862	9.4	Ah
861	8.5	Pt	861	12.6	Pt	861	9.5	Fn	*090031*			857	9.6	Ra	864	9.9	Ra
861	8.3	Hm	863	12.5	Es	861	8.5	Pt	833[	13.0	Bl	858	9.8	Hb	864	10.0	Dl
861	8.7	Fn	871	12.6	Kg	862	9.0	My	858[	13.0	Bl	861	8.7	Pt	865	10.2	Dl
862	8.2	Hm	W Pup			875	8.9	My	V UMa			861	9.6	Fn	865	9.5	Jo
862	8.6	Dl	*074241*			R Cha			*090151*			861	8.9	Hm	865	9.7	Ba
864	8.5	Dl	809	11.9	En	*082476*			855	10.1	Mc	865	9.0	Hm	868	10.3	Dl
865	8.5	Hm	811	11.7	Bl	813[	12.6	Sl	860	10.3	Mc	867	9.0	Rc	869	9.0	Mc
868	8.5	Dl	829	10.5	En	833	13.2	Bl	W Cnc			870	8.7	Pg	870	9.2	Pg
870	9.0	Dl	833	10.0	Bl	843[	12.6	En	090425			870	8.9	Gy	870	9.8	Ba
870	8.5	Hm	844	9.6	En	849	12.6	Bl	836	12.4	Hk	R LMi			870	9.7	Jo
870	8.5	Pg	849	9.3	Bl	856	12.4	Bl	861	13.5	Pt	093934			870	10.0	Ra
870	8.4	Ra	856	9.0	Bl	862	12.4	Bl	RX UMa			859	12.1	Hi	870	10.0	Dl
871	8.7	Sx	862	9.0	Bl	U Cnc			090567			861	11.8	Pt	871	10.0	Dl
871	8.9	Kg	T Gem			083019			833	9.8	Ks	870	11.9	Gy	871	9.8	Sx
T CMi			074323			820	10.2	Fc	RW Car			RR Hya			1 Car		
072811			820	10.4	Ks	828	11.2	Fc	*091868*			*094023*			*094262*		
860	11.8	Hk	826	10.7	Ks	836	10.7	Hk	807	12.2	En	748	13.8	Bm	799	3.4	En
861	11.7	Pt	854	12.9	Wd	836	10.4	Fr	811	12.2	En	761	13.6	Bm	800	3.6	En
			858	13.0	Br	864	11.2	Cy	833	13.5	Bl	771	13.1	Bm	802	3.4	En
			861	13.0	Pt				835	12.8	En	779	12.5	Bm	807	3.4	En

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J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
		1 CAR			U UMA			W LEO			Z UMA			U CEN			S UMA
		094262			100860			104814			115158			*122854*			123961
809	3.8	En	833	6.5	Ks	779	10.2	Bm	854	6.4	Kp	836	7.8	Bl	838	10.5	Si
811	3.8	En			Z CAR	786	10.3	Bm	855	7.0	Pg	849	8.3	Bl	850	9.0	Ra
815	4.2	En			*101058a*	798	10.4	Bm	861	6.6	Kp	856	8.5	Bl	853	9.0	Ah
818	4.3	En	809[	12.6	En	811	10.6	Bm	862	6.9	Kp	862	8.6	Bl	855	8.9	Rc
819	4.3	En	833	12.0	Bl	821	11.4	Bm	870	7.0	Pg			T UMA	856	8.5	Sq
827	4.7	En	835	11.0	En	836	12.0	Fr			R COM			123160	858	8.7	Ah
829	4.2	En	849	11.2	Bl	863	12.1	Es			115919	861	12.3	Jo	860	9.3	Mc
835	3.6	En	856	10.8	Bl			RS CAR	836	10.7	Ar	861	12.6	Pt	861	8.7	Jo
841	4.2	En	862	10.4	Bl			*110361*	861	9.6	Jo	865	12.4	Wd	861	8.8	Rc
842	3.8	En			W VEL	835[	12.3	En	865	9.5	Jo	865	12.3	Jo	861	8.5	Hm
843	3.9	En			*101153*			S LEO	870	9.1	Jo	870	12.4	Jo	861	8.8	Wh
844	4.0	En	811[	13.0	En			110506	870	8.7	Gy	870	12.2	Gy	861	8.8	Pt
846	3.8	En	833[	13.0	Bl	861	12.0	Pt			SU VIR			R VIR	862	8.7	Wd
		Y HYA	858[	13.0	Bl	863	12.1	Es			120012			123307	864	8.4	Dl
		094622			U HYA	871	12.4	Cy	861[	12.0	Pt	836	9.2	Hk	865	8.5	Dl
835	8.0	En			*103212*			RY CAR			T VIR	858	7.3	Ah	865	8.5	Jo
861	6.7	Pt	861	7.0	Hm			*111561*			*120905*	861	7.7	Jo	865	8.5	Hm
		Z VEL	862	5.2	Si	811	11.2	Bl	861[	12.5	Pt	861	7.3	Fn	865	8.5	Wd
		094953			RZ CAR	811	11.6	En			R CRV	861	7.2	Pt	866	8.7	Rc
811	12.8	En			103270	827	11.6	En			*121418*	862	6.8	Si	868	8.5	Dl
833	13.5	Bl	835	13.1	En	835	11.3	En	761	13.9	Bm	862	7.1	Ah	869	8.7	Mc
835	13.2	En			R UMA	843	11.3	En	779	13.0	Bm	865	7.6	Jo	870	8.4	Dl
858	13.0	Bl			103769	836	11.0	Bl	786	13.0	Bm	870	7.5	Jo	870	8.2	Jo
		V LEO	838	11.0	Si	849	11.1	Bl	798	11.8	Bm			RS UMA	870	8.8	Gy
		095421	850	11.2	Ra	856	11.2	Bl	811	10.5	Bm			123459	870	8.3	Hm
861	13.5	Pt	854	11.8	Wd	862	12.2	Bl	821	10.0	Bm	779	14.0	Bm	871	8.4	Sx
863	12.3	Es	859	11.5	Hi			RS CEN	836	9.1	Hk	786	13.9	Bm	871	8.5	Dl
		RR CAR	861	11.6	Pt			*111661*	861	7.1	Pt	798	13.1	Bm	874	8.4	Rc
		095458	861	11.8	Jo	809	9.1	En	863	7.8	Wd	811	11.7	Bm			RU VIR
811	7.7	En	861	11.0	Ba	811	9.1	En			SS VIR	821	10.5	Bm			124204
835	7.5	En	865	11.2	Ba	811	9.2	Bl			122001	836	9.3	Ry	836	12.6	Hk
		RV CAR	865	11.9	Jo	827	8.9	En	836	9.3	Hk	840	9.1	Ry	861	12.9	Pt
		095563	870	11.6	Gy	833	9.0	Bl	861	8.0	Jo	843	9.2	Ry			U VIR
811[	13.1	En			V HYA	835	8.6	En	865	7.8	Jo	848	9.3	Ry			124606
833[	13.1	Bl			*104620*	836	8.9	Bl	870	7.8	Jo	850	9.8	Ra	836	9.5	Hk
858[	13.1	Bl	811	7.4	Bl	843	9.0	En			T CVN	855	9.8	Rc	861	10.6	Pt
		S CAR	833	7.5	Bl	849	9.0	Bl			122532	855	9.8	Mc	871	11.0	Ra
		100661	836	8.1	Hk	856	9.1	Bl	861	10.9	Jo	856	10.0	Sq			RV VIR
806	7.7	Sl	838	7.7	Si	862	9.7	Bl	861	10.3	Pt	859	10.1	Mc			*132022*
809	8.0	En	849	7.6	Bl			X CEN	863	11.1	Wd	860	9.6	Ry	870	11.7	Gy
811	8.2	En	856	7.7	Bl			*114441*	863	11.0	Cy	860	9.9	Je			U OCT
811	8.3	Bl	861	6.7	Pt	811	7.2	Bl	865	10.7	Jo	861	9.7	Je			*131283*
813	8.2	Sl	861	7.6	Jo	836	8.3	Bl	867	10.8	Rc	861	9.4	Jo	807[	13.2	En
827	9.3	Sl	862	7.9	Si	849	8.9	Bl	870	10.6	Jo	861	9.8	Pt	835	12.2	En
833	8.4	Bl	862	7.7	Bl	856	8.8	Bl	870	10.7	Gy	863	9.6	Wd	836	12.7	Bl
835	8.7	En	865	7.6	Jo	862	9.4	Bl	871	10.8	Cy	863	9.8	Cy	849	11.3	Bl
843	8.0	En	870	7.8	Jo			W CEN			Y VIR	864	9.9	Dl	856	11.0	Bl
849	7.8	Bl			RS HYA			*115058*			*122803*	865	10.0	Dl	862	10.9	Bl
856	7.4	Bl			*104628*	811	11.0	Bl	761	12.8	Bm	865	9.5	Jo			R HYA
862	7.0	Bl	811	11.8	Bl	811	11.1	En	786	13.6	Bm	865	9.6	Wd			*132422*
		U UMA	833	12.8	Bl	843	8.6	En	798	13.5	Bm	868	9.7	Dl	849	8.9	Bl
		100860	836	13.2	Hk	836	8.5	Bl	811	12.5	Bm	870	9.9	Dl	856	8.5	Bl
770	6.6	Hr	858	13.5	Bl	849	8.3	Bl	821	12.4	Bm	870	9.4	Jo	862	8.7	Bl
771	6.6	Hr			W LEO	856	8.3	Bl	875	9.0	My	870	9.9	Gy	861	7.2	Si
777	6.6	Hr			104814	862	8.3	Bl			U CEN	871	9.9	Sx	871	7.8	Pt
784	6.6	Hr	748	10.2	Bm			Z UMA			*122854*	871	10.0	Dl			S VIR
788	6.7	Hr	761	10.0	Bm			115158	811	8.4	Bl						*132706*
816	6.8	Hr	771	10.0	Bm	853	6.5	Kp	844	8.4	En				836	12.2	Hk

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J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
S VIR			U UMI			R BOO			S UMI			R CRB			S SCO		
132706			141567			*143227*			153378			154428			*161122b*		
871	12.3	Ra	844	9.2	Ah	858	11.6	Ah	864	8.9	Sf	870	9.2	Dl	872	12.7	Pt
RV CEN			853	9.3	Ah	861	11.5	Jo	865	9.4	Jo	871	9.0	Pt	W CRB		
133155			858	9.4	Ah	862	12.0	Ah	865	8.7	Dl	871	9.1	Cy	161138		
811	9.2	Bl	861	9.0	Jo	864	11.8	Ra	868	8.7	Dl	871	8.5	Ra	836	13.7	Ar
836	9.5	Bl	864	10.3	Ra	865	11.7	Jo	870	8.7	Dl	871	9.4	Hw	872[	12.8	Pt
849	9.0	Bl	865	9.4	Jo	870	11.5	Jo	870	8.8	Hm	871	9.1	Dl	V OPH		
856	9.2	Bl	870	9.5	Jo	871	12.5	Pt	870	8.8	Gy	872	9.0	Pt	162112		
862	9.0	Bl	871	10.4	Cy	U BOO			870	8.8	Jo	873	9.0	Pt	838	7.2	Si
T UMI			871	10.5	Pt	144918			871	8.4	Pt	874	9.0	Pt	872	7.8	Pt
133273			S BOO			864	12.4	Cy	R CRB			875	9.5	Hw	U HER		
861[	12.8	Gy	141954			870	12.5	Gy	154428			X CRB			162119		
T CEN			850	9.4	Ra	871	12.1	Cy	836	12.0	Ar	154536			856	11.3	Ar
133633			860	9.1	Hu	Y LUP			836	12.0	Dh	871[	12.2	Pt	856	11.2	Dh
836	6.5	Bl	861	9.4	Jo	*145254*			846	10.7	Si	R SER			870	10.9	Gy
849	6.0	Bl	865	9.2	Jo	836	11.2	Bl	850	9.9	Ra	154615			870	11.0	Dl
856	6.0	Bl	870	8.9	Jo	849	9.9	Bl	850	9.9	Pt	864	9.7	Cy	872	10.9	Pt
862	6.2	Bl	870	8.3	Gy	856	9.7	Bl	851	9.9	Pt	871	10.1	Pt	SS HER		
RT CEN			871	8.5	Pt	862	9.8	Bl	853	9.4	Ah	V CRB			162807		
134236			RS VIR			S APS			853	9.5	Pt	154639			872	10.7	Pt
836	11.0	Bl	142205			*145971*			853	10.1	Fa	864	10.2	Cy	W HER		
849	11.5	Bl	779	10.8	Bm	811[	12.5	Bl	854	9.3	Si	871	8.6	Pt	163137		
856	11.1	Bl	786	11.2	Bm	836[	13.4	Bl	856	8.7	Ar	RR LIB			856	12.4	Ar
862	11.7	Bl	798	11.6	Bm	856[	13.4	Bl	856	8.7	Dh	*155018*			856	12.3	Dh
R CVN			811	11.6	Bm	862[	13.4	Bl	857	9.4	Wp	871[	11.9	Pt	872	11.9	Pt
134440			821	12.0	Bm	RT LIB			857	9.4	Wa	T CRB			R UMI		
838	10.6	Si	836	12.5	Hk	*150018*			857	8.8	Pb	155526			163172		
850	11.1	Ra	V BOO			871	10.5	Pt	858	9.0	Ah	871	9.8	Pt	860	9.7	Mc
861	11.7	Jo	142539a			T LIB			858	8.7	Gy	RZ SCO			861	9.6	Jo
865	11.7	Jo	836	8.2	Dh	*150519*			859	8.5	Ar	*155823*			863	10.0	Wd
870	12.0	Jo	836	8.2	Hk	871[	12.0	Pt	860	8.9	Gy	871	9.7	Pt	864	9.4	Ra
871	11.7	Pt	850	8.7	Ra	S CRB			860	8.9	Ar	R HER			865	9.7	Jo
RX CEN			854	8.9	Wd	151731			860	8.6	Hk	160118			868	10.2	Dl
134536			858	8.8	Ah	836	10.7	Ar	860	8.6	Dh	870[	12.8	Gy	870	9.7	Jo
836[	12.1	Bl	861	8.7	Jo	864	11.6	Ra	861	9.0	Gy	U SER			R DRA		
858[	13.1	Bl	861	8.5	Hm	871	11.5	Pt	861	8.8	Pb	160210			163266		
T APS			862	8.8	Hm	RS LIB			861	9.1	Fn	864	10.4	Cy	844	9.1	Ah
134677			862	9.2	Dl	*151822*			861	8.9	Si	871	12.0	Pt	853	9.4	Ah
807	10.0	En	862	8.7	Ah	862	11.7	Bl	861	9.6	Fa	SX HER			853	9.3	Dl
811	10.5	Bl	863	9.3	Cv	RU LIB			862	8.9	Ah	160325			854	9.3	Dl
835	12.0	En	864	9.2	Dl	*152714*			862	8.4	Hf	836	8.1	Ar	854	9.8	Kp
836	11.7	Bl	865	9.2	Dl	871[	12.5	Pt	862	8.9	Kp	850	7.9	Pt	854	9.2	Hm
849	12.1	Bl	865	8.7	Hm	R NOR			862	9.5	Fa	860	7.9	Pt	861	10.0	Kp
858	12.7	Bl	865	8.9	Jo	*152849*			862	9.1	Dl	870	8.4	Gy	861	10.0	Jo
RR VIR			870	8.9	Jo	836	7.6	Bl	863	8.7	Wd	871	8.0	Pt	861	9.7	Dl
135908			870	9.3	Ra	849	7.3	Bl	863	8.6	Cy	872	8.0	Pt	861	9.7	Hm
871[	12.8	Pt	870	9.2	Dl	856	7.1	Bl	864	9.1	Dl	873	8.2	Pt	862	9.7	Hm
RU HYA			870	8.7	Hm	862	7.1	Bl	864	8.5	Wa	874	8.2	Pt	862	9.8	Kp
140528			871	9.0	Pt	S UMI			864	8.9	Wp	RU HER			862	8.7	Dl
849	11.6	Bl	871	9.3	Dl	153378			864	8.3	Cm	160625			863	10.3	Wd
856	10.6	Bl	R CAM			850	10.0	Ra	864	8.9	Ra	836	13.0	Ar	864	9.9	Dl
862	10.5	Bl	142584			853	10.5	Dl	864	8.4	Cy	871[	12.4	Pt	864	9.7	Ra
R CEN			861	9.5	Jo	854	10.4	Dl	865	9.1	Dl	R SCO			865	10.2	Jo
140959			864	9.8	Ra	854	9.3	Wd	865	8.3	Rb	*161122a*			865	10.1	Dl
811	7.8	Bl	865	10.0	Wd	861	9.0	Gy	865	8.9	Gy	811	14.4	Bm	865	9.5	Hm
836	6.6	Bl	865	9.8	Jo	861	9.4	Jo	865	9.3	Fa	872	10.5	Pt	870	11.0	Gy
849	6.2	Bl	870	10.3	Jo	861	8.2	Hm	870	9.2	Rb	S SCO			870	10.7	Jo
856	6.3	Bl				862	8.5	Hm	870	9.0	Gy	*161122b*			870	10.0	Dl
862	6.5	Bl				863	8.6	Hm	870	8.6	Fa	811	13.5	Bm	872	10.6	Pt

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1935.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
RR OPH			RY HER			RX LYR			TZ CYG			χ CYG			RU CAP		
164319			175519			185032			191350			194632			*202622*		
811	14.3	Bm	872	11.6	Pt	836	14.9	Ar	870	10.1	Gy	873	5.6	Pt	776	9.4	Bm
872[	12.0	Pt	V DRA			872[	12.5	Pt	872	9.8	Pt	NOV CYG			Z DEL		
S HER			175654			Z LYR			U LYR			195553			202817		
164715			872[	12.7	Pt	185634			191637			872[	12.2	Pt	873	12.8	Pt
836	11.1	Ar	T HER			872	13.0	Pt	872	11.9	Pt	Z CYG			ST CYG		
872	11.6	Pt	180531			R AQL			TY CYG			195849			202954		
RS SCO			870	9.3	Gy	190108			192928			873	11.7	Pt	870	11.0	Gy
164844			872	10.1	Pt	872	6.5	Pt	870	9.7	Gy	SY AQL			873	11.2	Pt
862	10.7	Bl	W DRA			V LYR			872	9.0	Pt	200212			V VUL		
SS OPH			180565			190529a			RT AQL			873	13.2	Pt	203226		
165202			861	13.3	Pf	872[	12.3	Pt	193311			S CYG			873	8.6	Pt
870[	12.2	Gy	872	10.5	Pt	RX SGR			*190818*			872	9.5	Pt	S DEL		
RV HER			X DRA			872[	12.2	Pt	R CYG			200357			203816		
165631			180666			RW SGR			193449			873	12.6	Pt	873	9.0	Pt
836	14.3	Ar	861[	13.4	Pf	*190819a*			855	7.6	Mc	S AQL			V CYG		
872	11.5	Pt	RY OPH			872	10.3	Pt	859	7.8	Mc	*200715a*			203847		
R OPH			181103			TY AQL			869	7.3	Mc	873	8.8	Pt	874	12.2	Pt
170215			372	11.6	Pt	*190907*			870	7.8	Gy	RW AQL			Y AQR		
870	9.3	Gy	W LYR			856	10.8	Ar	873	9.0	Pt	*200715b*			*203905*		
872	9.1	Pt	181136			872	11.0	Pt	RV AQL			873	9.3	Pt	752	14.3	Bm
RT HER			872	12.2	Pt	S LYR			193509			Z AQL			766	13.7	Bm
170627			SV HER			190925			873[	12.6	Pt	200906			776	12.2	Bm
836	12.7	Ar	182224			872[	12.3	Pt	T PAV			752	13.4	Bm	874	10.2	Pt
872[	12.9	Pt	872[	12.5	Pt	X LYR			*193972*			766	13.3	Bm	T DEL		
Z OPH			T SER			190926			836[	13.2	Bl	776	12.8	Bm	204016		
171401			182306			872	8.8	Pt	857[	13.2	Bl	RS CYG			874[	12.2	Pt
872	12.8	Pt	872	10.2	Pt	RS LYR			RZ UMA			200938			V AQR		
RS HER			X OPH			190933a			194048			838	9.1	Si	204102		
171723			183308			855	8.4	Mc	845	8.9	Si	874	7.5	Pt			
872	11.4	Pt	872	7.6	Pt	859	8.3	Mc	856	9.3	Ar	W AQR					
S OCT			RY LYR			872[	12.5	Pt	859	9.3	Ar	*204104*					
172486			184134			RU LYR			869	8.1	Mc	873	8.3	Pt	752	13.2	Bm
807	8.6	En	872[	12.5	Pt	190941			870	8.3	Gy	R DEL			758	13.1	Bm
811	9.2	Bl	R SCT			870	11.9	Gy	873	8.1	Pt	201008			766	13.6	Bm
825	9.7	Bl	*184205*			872	12.0	Pt	TU CYG			873	11.5	Pt	776	13.6	Bm
835	10.3	En	U DRA			190967			194348			SX CYG			T AQR		
836	10.1	Bl	764	5.6	Hu	836	9.4	Ry	836	9.4	Ry	201130			*204405*		
849	11.3	Bl	780	5.9	Hu	840	9.2	Ry	860	9.4	Ry	807[	12.6	Fc	874	10.5	Pt
856	11.5	Bl	848	6.9	Ra	861	9.5	Pf	870	9.6	Gy	873	13.0	Pt	RZ CYG		
862	11.8	Bl	850	6.0	Pt	864	9.5	Ra	873	9.4	Pt	WX CYG			204846		
RU OPH			856	6.4	Ar	872	9.3	Pt	X AQL			201437b			874	10.4	Pt
172809			856	6.4	Pb	W AQL			856	11.1	Ar	856	11.1	Ar	S IND		
870	11.1	Gy	859	5.8	Ar	*191007*			194604			859	11.1	Ar	204954		
872	10.8	Pt	860	6.0	Ar	856	9.6	Ar	859	11.1	Ar	860	11.2	Ar	811	9.4	Bl
W PAV			860	5.8	Pt	872	10.4	Pt	873[	12.9	Pt	V SGE			825	10.0	Bl
174162			866	5.8	Cm	T SGR			χ CYG			201520			836	10.9	Bl
858[	13.0	Bl	870	5.7	Gy	*191017*			194632			870	12.1	Gy	X DEL		
RS OPH			872	5.6	Pt	872	10.1	Pt	728	10.1	Eo	U CYG			205017		
174406			873	5.5	Pt	R SGR			744	10.0	Su	201647			874[	12.4	Pt
850	11.0	Pt	874	6.0	Wh	*191019*			745	10.0	Eo	838	8.5	Si	TW CYG		
860	11.1	Pt	NOV AQL			872	10.4	Pt	751	9.2	Eo	855	9.2	Mc	210129		
870	11.0	Gy	184300			RY SGR			751	9.3	Bn	859	9.3	Mc			
872	11.0	Pt	850	11.8	Pt	191033			751	10.0	Su	862	8.7	Ah	752	13.8	Bm
RT OPH			856	10.9	Ar	847	7.7	Bj	756	9.0	Eo	873	8.5	Pt	766	14.0	Bm
175111			859	11.0	Ar	860	8.1	Pt	814	9.0	Bn	RU CAP			776	13.8	Bm
872[	12.5	Pt	860	10.9	Ar	872	7.3	Pt	815	5.8	Gy	*202622*			795	13.2	Bm
			860	11.5	Pt	873	7.7	Pt	838	4.7	Si	752	10.0	Bm	Z CAP		
			862	11.5	Pt	S SGR			845	4.7	Si	758	9.4	Bm	*210516*		
			870	10.9	Gy	*191319a*			848	4.9	Ra	766	9.4	Bm	752	14.6	Bm
						872[	12.2	Pt	870	6.0	Gy						

Variable Star Observations Received During March, 1935.

J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.	J.D.	Est.	Obs.
Z Cap			T Cep			RV Cyg			RS Peg			V Cas			R Aqr		
210516			210868			213937			220714			230759			*233815*		
766	15.0	Bm	869	7.6	Mc	731	7.0	Su	776	12.2	Bm	836	8.1	Fn	807	11.0	En
776	14.9	Bm	870	7.8	Ba	731	7.0	Eo	795	10.2	Bm	836	8.1	Si	811	10.9	Bl
R Equ			870	7.2	Jo	735	7.6	Eo	805	9.4	Bm	847	7.7	Jo	830	11.2	Bl
210812			870	8.0	Dl	735	7.2	Bn	X Aqr			848	7.9	Fn	Z Cas		
752	14.5	Bm	870	7.4	Hm	735	7.2	Bw	*221321*			853	8.2	Ah	233956		
766	13.2	Bm	871	8.0	Dl	738	7.0	Su	752	10.9	Bm	854	7.8	Fn	854	13.8	Mg
776	12.7	Bm	874	6.6	Pt	738	7.2	Eo	766	11.2	Bm	855	8.0	Pg	RR Cas		
795	11.1	Bm	W Cyg			740	7.0	Eo	795	13.0	Bm	858	8.0	Ah	235053		
874	10.9	Pt	213244			744	7.2	Su	805	13.4	Bm	861	8.0	Jo	870	12.6	Gy
T Cep			855	6.8	Mc	744	7.2	Eo	T Gru			862	8.2	Ah	R Phe		
210868			859	6.8	Mc	751	6.9	Su	*221938*			864	8.2	Sf	*235150*		
844	7.8	Ah	869	6.9	Mc	751	6.9	Bn	807	11.2	En	865	8.0	Jo	803	11.6	En
847	7.0	Jo	S Cep			751	6.9	Eo	S Gru			870	8.5	Jo	V Cet		
853	7.5	Ah	213678			756	7.0	Eo	*221948*			874	8.4	Pt	*235209*		
853	7.6	Kp	847	10.3	Jo	789	6.8	Bw	803	9.4	En	W Peg			811	11.1	Bl
853	8.2	Dl	850	9.4	Dt	789	6.8	Bn	807	9.5	En	231425			830	9.3	Bl
853	7.6	Hm	855	9.5	Dt	814	6.9	Bn	815	10.3	En	828	9.3	Sx	R Tuc		
853	7.7	Hb	861	10.0	Dt	814	6.7	Bw	827	10.3	En	847	8.0	Jo	*235265*		
854	7.8	Wd	861	10.5	Jo	874	6.8	Pt	835	10.7	En	V Phe			799	[12.9	En
854	7.6	Kp	861	11.3	Ba	RR Peg			S Lac			*232746*			806	[13.5	Sl
854	8.2	Dl	864	11.0	Ra	214024			222439			827	[12.7	En	836	[12.9	En
854	7.8	Hm	865	10.8	Jo	836	10.5	Es	828	9.2	Sx	Z And			R Cas		
855	7.7	Rc	865	11.4	Ba	R Gru			R Ind			232848			235350		
858	7.6	Ah	872	10.0	Dt	*214247*			*222867*			835	10.6	Pb	828	10.0	Sx
859	8.1	Dl	873	10.0	Dt	800	12.1	En	803	[13.5	En	837	10.5	Ar	847	9.9	Jo
861	8.6	Ba	874	10.2	Pt	803	12.2	En	835	[13.5	En	838	10.5	Cy	854	10.2	Kp
861	7.6	Kp	RU Cyg			807	12.4	En	857	[13.5	Bl	843	10.6	Md	854	10.1	Dl
861	8.2	Dl	213753			829	[11.6	Bl	T Tuc			860	10.7	Pb	854	10.2	Wd
861	7.9	Hm	836	8.2	Ry	Y Peg			*223462*			861	10.7	Pb	861	10.0	Kp
862	7.5	Hm	840	8.2	Ry	*220613*			803	13.3	En	ST And			861	10.1	Dl
862	7.6	Ah	847	8.3	Jo	752	12.4	Bm	827	12.3	En	233335			861	10.0	Jo
862	7.5	Kp	855	9.2	Mc	766	13.6	Bm	835	10.9	En	738	9.2	Cy	862	10.0	Kp
862	8.1	Dl	860	8.1	Ry	776	14.5	Bm	RW Peg			847	9.0	Jo	865	10.3	Jo
864	7.6	Ra	874	8.3	Pt	795	14.4	Bm	225914			861	9.0	Jo	865	11.2	Wd
865	8.1	Dl	kV Cyg			805	[14.8	Bm	755	11.2	Bm	862	8.9	My	865	10.1	Dl
865	7.4	Hm	213937			RS Peg			766	11.8	Bm	865	9.2	Jo	868	10.1	Dl
865	7.5	Jo	*727*	6.9	Bw	*220714*			786	12.2	Bm	870	9.0	Jo	870	10.2	Jo
865	7.8	Ba	*727*	6.9	Bn	752	12.8	Bm	805	12.8	Bm				870	10.7	Gy
866	7.9	Rc	*728*	7.2	Eo	766	12.5	Bm	817	13.6	Bm						
868	8.0	Dl	728	7.2	Su				827	13.8	Bm						

Rapidly Varying Irregular Variables.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.	Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
005840 RX Andromedae—							020356 UV Perseus—						
	7813.7	13.5	Br	7844.5	10.7	Hf		7840.7	[13.9	Br	7865.6	[12.7	Bj
	7827.2	12.3	Fc	7845.5	11.1	Hf		7858.7	[13.7	Br			
	7830.3	12.0	Fc	7846.5	11.3	Hf	060547 SS Aurigae—						
	7834.2	11.3	Fc	7854.6	11.7	Pt		7748.5	14.4	Bm	7811.4	14.8	Bm
	7835.6	11.9	Wu	7858.7	11.7	Br		7760.4	[14.5	Bm	7813.7	11.3	Br
	7836.4	12.5	Ry	7860.4	12.5	Ry		7771.5	[14.5	Bm	7815.5	11.4	Gv
	7837.5	13.2	Ar	7860.6	12.9	Pt		7776.1	11.9	Bm	7817.1	12.2	Bm
	7838.3	13.3	L	7861.7	12.8	Pt		7779.4	14.0	Bm	7826.3	14.7	Fc
	7840.4	13.0	Ry	7863.	12.0	Cy		7786.4	14.1	Bm	7827.1	[14.8	Bm
	7840.7	12.8	Br	7865.5	12.0	Jo		7796.1	14.9	Bm	7831.3	[14.5	Fc
	7842.4	12.3	Ry	7870.5	11.7	Gy		7798.4	[13.9	Bm	7833.3	14.8	Fc
	7843.4	12.0	Ry					7805.1	[14.5	Bm	7834.4	14.5	Ks

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1935.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
060547 SS AURIGAE—						
	7835.8	[13.9	Es	7859.7	[13.9	Hi
	7836.8	14.3	Ar	7860.5	14.6	Ar
	7837.5	14.3	Ar	7861.7	14.4	Pf
	7840.7	[13.9	Br	7863.7	14.6	Wa
	7841.5	[13.2	Ry	7863.8	14.2	Es
	7842.7	[13.9	Hi	7864.6	14.6	Wp
	7843.4	[13.2	Ry	7864.6	14.7	Wa
	7844.7	[13.2	Hi	7865.7	[13.2	Gy
	7848.4	11.5	Ry	7867.6	[13.8	Bj
	7850.8	[12.5	Ra	7869.7	12.6	Pt
	7852.6	[13.9	Wp	7870.6	10.8	Ie
	7853.6	14.6	Wa	7870.6	10.7	Gy
	7854.6	[12.6	Pt	7870.7	11.0	Fa
	7855.7	[13.8	Hi	7871.5	10.9	Ie
	7856.7	[14.0	Ar	7871.6	11.1	Wp
	7857.6	14.6	Wp	7871.6	11.2	Wa
	7857.6	14.7	Wa	7871.	10.7	Cy
	7858.5	14.6	Wp	7871.7	10.9	Pt
	7858.5	14.7	Wa			
074922 U GEMINORUM—						
	7748.5	14.5	Bm	7853.6	13.7	Wa
	7761.5	[13.7	Bm	7854.5	14.1	Ar
	7771.5	14.2	Bm	7854.6	13.3	Hf
	7779.5	14.2	Bm	7855.7	[12.4	Pk
	7786.5	14.2	Bm	7856.8	14.1	Ar
	7796.5	[13.7	Bm	7857.6	14.1	Wa
	7806.0	11.7	Sl	7857.6	14.2	Wp
	7811.5	13.8	Bm	7858.5	13.6	Wa
	7817.1	14.1	Bm	7858.5	13.6	Wp
	7817.1	14.1	Bm	7859.6	[13.3	Bj
	7826.3	14.1	Ks	7860.6	13.9	Ar
	7827.1	14.1	Bm	7861.7	[13.3	Fa
	7827.3	14.1	Fc	7862.7	[10.5	Si
	7831.3	14.3	Fc	7863.8	14.2	Es
	7833.7	[12.6	Mo	7864.7	14.3	Wp
	7836.8	14.1	Ar	7864.7	14.3	Wa
	7837.5	13.8	Ar	7865.7	[13.8	Gy
	7838.6	14.0	Wu	7869.7	[12.4	Pt
	7840.7	[13.8	Br	7870.7	[13.8	Gy
	7843.6	[13.6	B	7871.6	[13.8	Kg
	7853.6	13.8	Wp	7889.6	11.9	Rb
081473 Z CAMELOPARDALIS—						
	7813.7	13.3	Br	7858.7	13.0	Br
	7828.3	12.2	Fc	7859.7	12.5	Pt
	7836.4	†1.6	Ry	7860.6	12.7	Ry
	7836.8	12.0	Ar	7860.7	12.9	Pt
	7837.6	12.0	Ar	7861.7	12.7	Pt
	7840.4	11.9	Ry	7861.7	12.7	Fa
	7840.7	12.3	Br	7863.	11.4	Cy
	7841.5	12.1	Ry	7864.7	11.1	Wp
	7842.4	12.0	Ry	7864.	11.1	Cv
	7843.6	11.7	Ry	7864.7	10.9	Wa
	7848.5	12.2	Ry	7865.7	11.4	Gy
	7853.6	12.6	Wp	7865.7	10.9	Fa
	7853.6	12.7	Wa	7870.5	11.7	Gy
	7854.6	12.8	Pt	7871.6	11.7	Wp
	7857.6	12.8	Wa	7870.7	11.2	Fa
	7857.6	12.9	Wp	7871.6	11.6	Wa
	7858.5	12.9	Wp	7871.	12.1	Cy
	7858.5	12.9	Wa	7871.7	12.1	Pt
094512 X LEONIS—						
	7836.8	14.5	Ar	7861.7	[12.3	Gy
	7858.7	12.0	Gy	7867.6	[13.2	Bj
	7858.8	12.7	Br	7870.7	[12.3	Gy
	7860.7	12.9	Pt			
180445 NOVA HERCULIS—						
	7787.4	2.9	Do	7814.5	2.6	Du
	7789.4	2.8	Do	7814.5	2.7	MC
	7789.4	3.0	Du	7814.6	2.6	Pg
	7790.5	2.5	Do	7814.7	2.5	Ks
	7792.5	2.1	Do	7814.9	2.5	MC
	7792.6	2.1	Du	7815.0	2.2	Se
	7798.4	3.5	Du	7815.4	2.4	Se
	7798.4	3.5	Do	7815.4	2.3	Gy
	7798.4	3.4	Se	7815.5	2.2	Gy
	7798.9	2.5	Du	7815.5	2.3	Do
	7799.0	2.6	Se	7815.7	2.5	Ks
	7799.4	2.3	Se	7816.9	2.1	MC
	7800.0	2.3	Se	7817.0	2.3	Se
	7801.4	2.5	Se	7817.4	2.4	Se
	7802.0	2.5	Se	7817.5	2.3	MC
	7802.4	2.7	Se	7817.9	2.5	Du
	7802.5	2.9	Du	7817.9	2.1	MC
	7802.6	2.6	Pg	7818.5	2.6	Du
	7802.6	2.6	Pg	7818.5	2.5	MC
	7803.0	2.5	Se	7818.6	2.9	Ks
	7803.5	2.6	Du	7820.2	2.7	Fc
	7803.6	2.6	Pg	7820.2	2.7	Ks
	7804.5	2.7	Se	7820.2	2.5	Pd
	7804.5	2.8	Du	7820.5	2.4	MC
	7804.5	2.5	MC	7820.6	2.5	Ks
	7805.4	2.3	Se	7820.9	2.5	MC
	7805.5	2.7	Du	7821.4	2.0	Do
	7805.5	2.6	MC	7821.7	2.1	Ks
	7805.9	2.8	MC	7823.2	2.5	Pg
	7806.0	2.3	Se	7824.5	2.5	MC
	7806.2	3.0	Fc	7825.5	2.4	Gy
	7806.2	2.8	Ks	7825.6	2.6	Ks
	7806.2	2.9	Pd	7825.7	2.4	Fc
	7806.5	2.7	Se	7826.2	2.9	Fc
	7806.5	2.8	MC	7826.2	2.9	Ks
	7806.5	2.6	Du	7826.2	3.0	Pd
	7807.0	2.7	Se	7826.9	2.5	MC
	7807.0	2.6	MC	7827.2	2.7	Ks
	7807.2	2.2	Pd	7827.2	2.7	Fc
	7807.2	2.6	Fc	7827.4	2.3	Du
	7807.4	2.7	Se	7827.5	2.6	MC
	7807.5	2.7	MC	7827.6	2.5	Ks
	7807.5	2.6	Du	7828.0	1.8	Sx
	7808.0	2.5	Se	7828.5	2.5	MC
	7808.5	2.4	Du	7829.6	2.2	Ks
	7808.6	2.6	Pg	7830.2	2.7	Fc
	7810.2	2.6	Ks	7830.5	2.4	MC
	7812.9	2.8	MC	7830.2	2.8	Pd
	7813.5	2.6	MC	7830.5	2.3	Gy
	7813.7	2.5	Ks	7830.9	2.4	Du
	7813.9	2.4	Du	7831.6	3.2	Ks
	7814.0	2.3	Se	7831.6	3.0	Pd
	7814.4	2.4	Se	7832.6	3.3	Ks
	7814.5	2.4	Fs	7832.6	3.2	Pd
	7814.5	2.6	Do	7832.9	3.7	MC

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1935.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.	Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
180445	NOVA HERCULIS—						180445	NOVA HERCULIS—					
	7832.9	2.6	Du	7849.9	3.5	Pt		7857.9	2.9	Pb	7863.9	3.5	Fn
	7833.6	3.8	Ks	7849.9	3.4	Mg		7858.4	2.3	Ah	7863.9	3.8	Sf
	7833.9	2.7	Du	7849.9	3.3	Bj		7858.5	2.0	Ah	7864.7	3.7	Wa
	7833.9	3.7	MC	7849.9	2.9	Ba		7858.7	2.6	MC	7864.7	3.6	Wp
	7834.6	3.2	Ks	7849.9	3.3	Pm		7858.7	3.2	Sf	7864.7	4.0	Dl
	7834.6	2.9	Pd	7850.2	3.7	Ra		7858.8	2.9	Hf	7864.8	3.7	MC
	7834.8	2.9	L	7850.8	3.2	Fr		7858.8	2.7	Ba	7864.8	3.6	Cm
	7835.5	3.0	Pd	7850.8	3.3	Dh		7858.8	2.8	Bz	7864.8	3.8	Cv
	7835.8	3.6	MC	7850.9	3.5	Mg		7858.9	2.8	Ra	7864.8	3.4	SG
	7835.9	2.8	Pb	7850.9	3.2	Pm		7859.0	2.5	Sx	7864.9	3.7	Ra
	7836.6	3.2	Pd	7850.9	3.6	Pt		7859.1	2.8	Hi	7865.7	4.0	Rb
	7836.8	3.1	Hk	7851.8	3.1	Fr		7859.8	3.0	Hk	7865.7	3.8	Fa
	7836.8	3.0	Si	7851.9	2.8	Mg		7859.8	2.9	Fr	7865.7	3.9	Gy
	7836.8	2.9	Dh	7851.9	2.6	Sf		7859.9	2.9	Hk	7865.7	4.1	Uw
	7836.9	2.9	Hk	7852.1	3.5	Hi		7860.0	2.9	Hk	7865.8	4.2	Hw
	7836.9	2.9	Fr	7852.2	2.8	Ra		7860.0	2.9	Pm	7865.7	3.9	C
	7837.0	3.1	Fn	7852.8	3.4	Hu		7860.1	2.9	Pg	7865.8	4.0	Sf
	7837.2	3.0	Be	7853.0	3.2	Mg		7860.1	3.2	Ra	7865.8	4.0	Ie
	7837.6	3.3	Pd	7853.0	3.4	Hk		7860.7	3.0	Lf	7865.8	3.5	Ba
	7837.9	3.5	Ko	7853.4	3.3	Ah		7860.7	3.8	Mc	7865.8	3.8	To
	7838.0	3.1	Si	7853.5	3.0	Ah		7860.7	3.2	Hu	7865.8	3.5	Cu
	7838.7	2.9	L	7853.7	3.0	Lf		7860.7	3.2	Hk	7865.9	3.8	Bj
	7838.8	3.1	Si	7855.8	3.3	MC		7860.7	3.2	Pt	7865.9	3.6	SG
	7838.8	2.8	MC	7853.8	3.5	Hk		7860.8	3.3	Hk	7866.0	4.0	Cm
	7838.9	2.5	Du	7853.8	3.3	Fr		7860.8	3.2	Dh	7867.1	3.6	Ra
	7838.9	2.9	Fn	7853.8	3.4	Si		7860.9	3.3	Pb	7869.7	3.6	Bs
	7839.0	2.9	Fn	7853.9	3.4	Ie		7860.9	3.1	Hk	7869.7	3.5	Mc
	7839.0	3.1	Si	7853.9	3.4	Hk		7861.0	2.9	Mg	7869.8	3.5	Bz
	7839.0	3.0	Si	7853.9	3.2	Ba		7861.1	2.9	Hi	7869.9	3.7	Ra
	7840.6	2.5	Pd	7853.9	3.6	Fa		7861.7	3.5	Fa	7870.7	3.9	Gy
	7840.8	2.9	Fr	7853.9	3.5	Pt		7861.7	3.2	Gv	7870.7	4.1	Cm
	7843.0	2.4	Hk	7854.0	3.3	Mg		7861.8	3.5	Pb	7870.7	3.6	Wa
	7843.6	2.6	Pd	7854.0	3.2	Cm		7861.8	3.3	Hf	7870.7	3.6	Dl
	7843.7	2.8	Ks	7854.0	3.2	Rb		7861.8	3.2	Fn	7870.7	3.8	Bs
	7844.0	2.9	Mg	7854.5	3.1	Ah		7861.8	3.4	Si	7870.7	4.1	Fa
	7844.2	2.9	Ra	7854.8	3.8	Kp		7861.9	2.9	Ba	7870.7	3.9	Rb
	7844.5	2.4	Ah	7854.8	3.3	MC		7861.9	3.4	Ie	7870.7	4.0	Sf
	7844.6	3.1	Ks	7854.8	3.3	Sf		7861.9	3.4	Si	7870.8	3.5	Ba
	7844.6	2.7	Pd	7854.8	3.3	Si		7862.0	3.3	Si	7870.8	3.9	Ie
	7844.9	2.8	Rb	7854.9	3.3	Bs		7862.0	3.3	Mg	7870.8	3.8	To
	7845.7	3.0	L	7855.0	3.6	Ra		7862.0	3.2	Cm	7870.9	3.8	Bj
	7845.9	3.1	Ko	7855.0	3.4	Mg		7862.5	3.3	Ah	7870.9	3.5	SG
	7845.9	3.0	Ba	7855.0	3.3	Rb		7862.7	3.8	Fa	7871.6	4.2	Kg
	7845.9	3.1	Bj	7855.8	3.7	MC		7862.8	3.8	Kp	7871.7	3.7	Hw
	7846.0	2.9	Bk	7856.0	3.4	Ra		7862.8	3.9	Ko	7871.7	3.7	Wa
	7846.0	3.1	Si	7856.0	3.1	Pm		7862.8	3.7	MC	7871.7	3.7	Dl
	7846.1	2.9	Ra	7856.4	2.6	Ah		7862.8	3.6	Hf	7871.7	3.4	Wd
	7846.1	3.0	Hi	7856.7	3.1	Lf		7862.8	3.7	Hw	7871.7	3.4	Pt
	7846.8	2.4	Rb	7856.7	3.0	Dh		7862.9	3.7	Bs	7871.7	3.7	C
	7846.8	3.0	Fr	7856.8	3.0	Pb		7862.9	3.6	Bz	7871.8	4.0	Cm
	7847.5	2.7	To	7856.8	2.7	Dh		7862.9	3.3	Pm	7871.8	3.5	Sf
	7847.9	2.8	Bj	7856.8	3.0	Fr		7862.9	3.8	Sf	7871.8	3.8	Cy
	7848.0	2.6	Mg	7856.9	2.8	Hk		7863.0	3.7	Bk	7871.9	3.7	Ra
	7848.0	2.8	Ra	7857.0	2.8	Mg		7863.1	3.1	Ra	7871.9	3.4	SG
	7848.9	3.3	Bj	7857.5	2.9	Ah		7863.8	3.8	To	7872.9	3.9	Pt
	7848.9	3.4	Pt	7857.6	3.5	Wp		7863.8	3.7	SG	7873.0	3.9	Sx
	7849.0	3.5	Cm	7857.7	3.5	Wa		7863.7	3.8	Bs	7873.9	4.0	Pt
	7849.0	3.5	Mg	7857.8	2.8	Gy		7863.8	3.9	Cy	7874.9	4.0	Pt
	7849.2	3.7	Ra	7857.8	3.0	Hf		7863.8	4.0	Wa	7875.7	3.9	Dl
	7849.8	3.5	MC	7857.9	3.0	Bz		7863.8	3.9	Ba	7875.7	3.9	Bs

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1935.

Star	J.D.	Est.	Obs.	J.D.	Est.	Obs.
180445	NOVA HERCULIS—					
	7875.7	3.9	C	7879.7	4.1	C
	7875.8	3.9	SG	7879.9	4.1	Wf
	7875.9	3.8	Hw	7881.8	4.5	SG
	7876.8	3.7	Bz	7883.8	4.7	SG
202946	SZ CYGNI—					
	7850.9	9.0	Pt	7872.9	9.7	Pt
	7851.9	8.9	Pt	7873.9	9.6	Pt
	7853.9	9.0	Pt	7874.9	9.5	Pt
	7860.9	9.7	Pt			
213843	SS CYGNI—					
	7727.6	8.6	Bw	7738.	9.7	Su
	7727.6	8.8	Bn	7740.5	9.8	Eo
	7728.	8.8	Su	7743.6	11.0	Bw
	7728.5	8.8	Eo	7744.	11.3	Su
	7731.	8 9	Su	7744.5	11.5	Eo
	7731.5	9.0	Eo	7751.6	12.3	Bn
	7735.5	9.0	Eo	7751.	12.3	Su
	7735.6	8.9	Bw	7751.5	12.3	Eo
	7735.6	8.9	Bn	7756.6	12.6	Eo
	7738.6	9.6	Eo	7764.5	12.5	Bn
213843	SS CYGNI—					
	7764.5	12.5	Bw	7853.5	9.6	Wp
	7789.6	10.1	Bn	7853.5	9.7	Wa
	7789.6	9.7	Bw	7853.5	9.6	Rb
	7813.6	12.2	Br	7853.9	9.9	Fa
	7814.5	12.5	Bn	7854.5	10.0	Cm
	7836.5	11.7	Ar	7856.9	11.0	Ar
	7836.6	12.0	Es	7856.9	11.2	Gy
	7841.5	8.4	Hf	7858.5	11.5	Wa
	7844.5	8.2	Hf	7858.5	11.4	Wp
	7845.5	8.3	Hf	7859.9	11.7	Ar
	7845.5	8.3	Rb	7860.0	11.5	Ar
	7846.5	8.6	Hf	7860.7	11.7	Pt
	7846.5	8.3	Rb	7861.5	11.5	Rb
	7847.5	8.6	Jo	7861.5	11.7	Cm
	7847.9	8.5	Bj	7864.5	11.7	Wp
	7848.9	8.5	Bj	7864.5	11.8	Wa
	7849.9	8.6	Bj	7866.0	11.8	Cm
	7850.6	8.7	Ra	7872.9	11.9	Pt
	7850.9	9.1	Pt	7873.9	11.8	Pt
	7853.5	9.7	Hf	7874.9	11.9	Pt

SUMMARY FOR MARCH, 1935.

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Ahnert	Ah	20	61	Gaposchkin,S.	SG	1	8
Armfield, D.	Af	12	12	Gregory	Gy	74	114
Armfield, L. E.	Ar	39	80	Halbach	Hk	32	48
Baldwin	Bl	59	230	Hamilton	Hm	22	101
Ballhaussen	Ba	10	30	Hartmann	Hf	8	37
Bappu	Bm	36	196	Harwood	Hw	2	7
Belsham	Bj	11	16	Heines	Hh	6	8
Benini	Be	4	5	Hildom, A.	Hi	10	20
Bennett	Bn	4	22	Holmes	Hg	2	2
Blunck	Bu	3	4	Holt	Hb	8	8
Bouton	B	2	2	Houston	Hu	14	28
Brocchi	Br	23	35	Howes	Hv	3	11
Brockmeyer	Bk	2	3	Huruhata	Hr	1	6
Brown, S. C.	Bs	3	8	Iedema	Ie	7	11
Brydon	Bz	1	5	Jansen	Je	7	14
Burnes	Bw	3	20	Jones	Jo	74	215
Callum	Cl	7	8	King	Kg	8	9
Campbell	C	1	4	Kirkpatrick	Kp	10	31
Christman	Cm	6	15	Kohman	Ko	1	3
Cilley	Cy	30	50	Kotsakis	Ks	39	73
Cunningham	Cu	1	1	Lacchini	L	10	12
Dalton	Dt	2	6	Loepfe	Lf	4	10
Diedrich	Dh	15	32	Miczaika	Mx	3	7
Dodson	Do	1	8	Millard	Md	7	7
Doolittle	Dl	28	155	Monnig	Mg	5	16
Duncan	Du	1	20	Moore	Mo	3	4
Ellis	Es	20	25	Morse	Mb	3	3
Ensor	En	59	183	McCormick Observatory	MC	1	32
D'Esopo	Eo	4	33	McLeod	Mc	18	32
Farnsworth	Fa	10	26	McKnelly	My	18	29
Fish	Fs	6	9	Peck	Pb	8	30
Focas	Fc	63	95	Peltier	Pt	201	252
Frister	Fr	18	34	Perkinson	Pk	1	1
Friton	Fn	14	25				

VARIABLE STAR OBSERVATIONS RECEIVED DURING MARCH, 1935.

Observer	Initial	Vars.	Observations	Observer	Initial	Vars.	Observations
Plakidis	Pd	1	14	Smith, L.	Sh	4	4
Preucil	Pf	8	8	Smith, F.P.	Sq	8	9
Previll	Pm	2	14	Smith, F.W.	Sf	9	16
Purdy	Pg	6	17	Stern, N.	Su	4	20
Raphael	Ra	67	95	Thomas	To	1	3
Recinsky	Rc	9	20	Wade	Wh	7	7
Rosebrugh	Rb	6	15	Walton	Wu	5	5
de Roy	Ry	10	45	Watson, F.	Wf	1	1
Salanave	Sx	34	65	Watson, P.S.	Wa	10	44
Schenkman	Se	1	21	Webb	Wd	41	50
Shinkfield	Sl	15	27	Woods	Wp	10	39
Simpson, J.W.	Si	38	60				
				Totals		90	372	3246

proximately the seventh magnitude, while on April 3 it had reached magnitude 8.4. On March 31, it was approximately of magnitude 5.0. Nova Herculis has thus indicated its close resemblance to Nova Aurigae of 1891 and observers should be on the watch to note whether or not the former rises to a secondary maximum, a few months hence, as did Nova Aurigae in 1892.

R Coronae Borealis, while on the general rise to maximum, is subject to marked oscillations in light. S Pavonis is still invisible, fainter than 13.0. SU Tauri appears to have attained normal maximum, magnitude 9.5.

SS Cygni was at maximum in February, while SS Aurigae was bright again on March 8. U Geminorum appears to have been on the wane from maximum on March 27 and 28.

LEON CAMPBELL, Recorder.

April 4, 1935.

Comet Notes

By G. VAN BIESBROECK

Neither new nor expected comets have been discovered this month. Little is to be said about the faint comets now under observation.

There have been a good many measures on COMET 1935 *a* (JOHNSON) which, being now a circumpolar object, can be observed at all hours of the night. It has followed very closely the ephemeris given on p. 255 except that these last weeks the brightness has diminished very much faster than expected. At the end of March the object, reduced to magnitude 11, had become extremely diffuse, nearly 3′ in diameter with little condensation and no longer any trace of a tail. Seen on a transparent moonless sky last night it appeared less than 1′ in diameter, and showed no nucleus. The total brightness was reduced to that of a star of magnitude 14, two magnitudes fainter than the computed value. In spite of its favorable position this object will therefore soon become too faint for further measures.

Two other faint comets are observable but only in reach of powerful instruments: PERIODIC COMET 1928 I (REINMUTH) is hardly brighter than $16^{M}.5$ (April 7) but still shows a faint indication of tail on the following side. It will be difficult to follow this object after its perihelion on May 1.8. PERIODIC COMET 1925 II (SCHWASSMANN-WACHMANN) has displayed again considerable variations in brightness: It failed to appear on a plate exposed here March 27 showing stars

down to $17^{M}.5$, but on April 7 it appeared as bright as 15^{M}, most of this light being concentrated in a diameter of only 10″.

The search for PERIODIC COMETS 1930 VI (SCHWASSMANN-WACHMANN) and 1929 II (FORBES) has not been successful so far, neither here nor elsewhere.

Williams Bay, Wisconsin, April 22, 1935.

Meteor Notes from the American Meteor Society

By CHARLES P. OLIVIER, President

On many occasions members of the American Meteor Society have undertaken coöperative observations, and often a number of meteor heights have rewarded these efforts. In fact, several hundred heights have been obtained in the past few years. Of the many methods that have been devised for the computation of heights from observation, three are fully described by me in a paper published by the Hydrographic Office, U. S. Navy, on the back of *Pilot Chart of the North Atlantic Ocean*, 1931. One of these three methods, Professor J. M. Schaeberle's, is also fully given in my book, *Meteors*, as taken from *Lick Observatory Contributions No. 5*. As this method at times leads to erroneous conceptions of the accuracy obtained, I suggested some time ago to Mr. F. W. Smith, then working as a volunteer on the Flower Observatory staff, that he compute a set of observations by this method which would illustrate the apparent but unreal accuracy in the calculated results. His report of this work, based on observations in August and October, 1930, is the second part of these notes.

The observations on 1930 August 11 were made under the handicaps of bright moonlight and short base lines. Only what were considered certain duplicates were included. The three stations were Green Lane, Pennsylvania, (S1), Swarthmore, Pennsylvania, (S2), and Glenolden, Pennsylvania, (S3). The constants were:

For S1-S2:	A_2	= 336° 59′.5
	D_2	= −48° 37′.7
	log k	= 7.88885
For S1-S3:	A_2	= 344° 14′.6
	D_2	= −47° 19′.0
	log k	= 7.90228

The observations made on 1930 October 21 had the advantage of a very much longer base line.

All the computations were made by F. W. Smith. We are under many obligations to him for this work and much other voluntary assistance.

Meteor Heights by Schaeberle's Method

By F. W. SMITH

Schaeberle has given in *Contributions of the Lick Observatory No. 5* (1895), two methods for computing the linear height of the beginning or end point of a meteor from duplicate observations. The first of these utilizes both observed right ascensions but only one declination; that is, it utilizes only that component of the parallactic displacement which is parallel to the celestial equator. In the second and longer method, both declinations as well as both right ascensions are introduced. The first method will give an unsatisfactory result if the position of the meteor and the azimuth of the line connecting the observing stations are such

that the parallactic displacement is in a direction nearly perpendicular to the equator. Obviously the component which is parallel to the equator will then be small compared with the total displacement, and the computed values will be more seriously affected by the comparatively large errors which are common to all naked eye observations of meteors. In such a case the second method, which takes into account the component in declination of the displacement, will give a more satisfactory result. If, on the other hand, the parallactic displacement is nearly parallel to the equator, the first method may be used to advantage. These

TABLE I

HEIGHTS OF PERSEIDS—AUGUST 11, 1930

			Beginning			Ending			
No.	E.S.T.	Mag.	Long.	Lat.	Height km	Long.	Lat.	Height km	Rem.
1	12:04	2	74 46.2	41 24.2	65.1	75 03.1	41 04.5	35.1	1
		2	74 46.2	41 25.4	67.0	75 03.1	41 07.1	39.5	2
					66.0			37.3	*
2	12:13	3	74 04.5	41 20.2	127.6	74 41.7	40 53.6	67.0	1
		4	74 04.5	41 33.9	150.5	74 41.7	41 07.8	88.9	3
					139.0			78.0	*
3	12:33	2				75 59.8	40 29.8	49.8	1
		2				75 48.5	40 23.1	50.4	2
								50.1	*
4a	13:21	2	74 22.7	40 48.2	179.9	75 00.5	40 20.2	89.3	1
		1	74 23.2	40 48.1	179.2	75 02.5	40 20.1	89.3	2
					179.6			89.3	*
4b		2	74 28.2	40 45.8	163.3	75 02.8	40 20.4	81.0	1
		3	74 21.9	40 46.4	167.8	75 02.7	40 20.3	81.0	2a
					165.6			81.0	*
4c		2	74 18.9	40 49.7	190.7	74 58.7	40 20.3	96.3	1
		2	74 24.5	40 49.7	189.4	75 05.1	40 19.5	100.8	3
					190.0			98.6	*
5	13:45	2	74 52.1	40 23.6	135.9	75 11.8	40 10.7	81.6	1
		2	74 58.2	40 23.4	137.8	75 15.7	40 10.1	84.2	2
					136.8			82.9	*
6	14:16	4	75 23.9	40 54.9	84.2	75 34.0	40 55.1	76.5	1
		3	75 24.8	40 59.7	98.2	75 34.9	40 46.1	57.4	2
					91.2			67.0	*
7	14:24	3	74 58.7	40 44.6	104.6	75 09.5	40 35.4	72.1	1
		2	74 44.9	40 47.2	131.4	75 02.3	40 36.7	86.1	2
					118.0			79.1	*
8	14:24	2	74 58.4	40 15.1	139.7	75 19.1	40 03.7	67.6	1
		1	75 01.8	40 15.4	139.0	75 16.9	40 03.8	67.6	2
					139.4			67.6	*

REMARKS:

1 Observed from Green Lane, Pa., by C. P. Olivier.
2 Observed from Swarthmore, Pa., by R. H. Wilson, Jr.
2a Observed from Swarthmore, Pa., by J. H. Pitman.
3 Observed from Glenolden, Pa., by F. W. Smith.
* Mean of the two heights.

facts have been taken into consideration in deciding upon the method of reduction used in each of the individual cases of Tables I and II. The first method was used for all of Table II and for the first two meteors in Table I. The mean beginning and end heights for the eight meteors in Table I are, respectively, 124.1 km and 69.0 km.

TABLE II

HEIGHTS OF METEORS—OCTOBER 21, 1930

No.	E.S.T.	Mag.	Beginning Long.	Lat.	Height km	Ending Long.	Lat.	Height km	Rem.
1	14:17	3	78 01.8	38 24.8	163.9	77 43.6	38 28.2	84.8	1, 3
		1	78 01.8	38 23.9	163.3	77 43.6	38 25.1	79.7	2, 3
					163.6			82.2	*
2	14:26	3	76 59.2	38 57.8	95.7	77 11.5	39 05.4	53.6	1, 4
		1	76 59.2	38 51.9	87.4	77 11.5	39 00.9	46.6	2, 4
					91.6			50.1	*
3	14:45	2	73 48.4	38 39.9	164.6	74 42.3	38 28.0	111.6	1, 3
		2	73 48.4	38 41.3	166.5	74 42.3	38 21.2	102.0	2, 3
					165.6			106.8	*

REMARKS:

1 Observed from Glenolden, Pa., by F. W. Smith.
2 Observed from Frederick, Md., by F. F. Marsh.
3 Sporadic meteor.
4 Orionid.

As the moon was nearly full at the time of the August observations, it was thought advisable to watch toward the north. Several of the meteors therefore were seen within a few degrees of the Pole. When the coördinates of these meteors were substituted in the test equation it was found that the residuals obtained did not give a good indication of the accuracy of the observations. The declination enters the test equation as the tangent, and the tangent near 90° changes very rapidly for a small change in angle. These observations were therefore tested graphically. For this reason the usual table of test equation residuals has been omitted.

For each meteor the computations were carried out for each station. The heights thus obtained are in very close agreement in several cases, but this does not necessarily mean that the determinations are especially accurate. This fact is brought out in a striking manner by the results which were obtained for the meteor which appeared at $13^h 21^m$ on August 11 (Table I, computations 4a, 4b, and 4c). As this meteor was seen by one observer at Station 1, two observers at Station 2, and one observer at Station 3, three partially independent determinations of the heights of the beginning and end points could be made. The second, more accurate, method was used for all three determinations. The heights obtained by reducing the observations of any single pair of observers from two stations are very accordant, but when the results of the three pairs are considered together, much larger discrepancies are found. Totally independent determinations would probably give even greater discrepancies. Therefore it seems that any "probable errors" based on a comparison of the results obtained by a single pair of observations are only a partial index of the accuracy of the observations.

Meteor Heights, 1934 Leonid Epoch

PART I. EASTERN GROUP

By DORIS M. WILLS

Last November twelve stations in Pennsylvania, Maryland, the District of Columbia, New York, and New Jersey attempted coöperative observations of the Leonids. The personnel was as follows:

No. Location Observers and Assistants

1—Flower Observatory, Upper Darby, Pennsylvania. C. P. Olivier (1C), B. S. Whitney (1W), T. D. Cope, R. A. Binckley (1B), D. M. Wills. On November 15-16 this station was near Wayne, Pennsylvania; an additional observer, R. D. Case, was observing from Ardmore, Pennsylvania.

2—Naval Observatory, Washington, D. C. W. M. Browne, F. P. Scott, M. Sharnoff, Watts, Nordberg.

3—Woodstock College, Woodstock, Maryland. W. J. Miller, S.J., J. T. McCarthy, S.J., J. B. Hayes, S.J., M. F. McPhelin, S.J., T. A. Zegers, S.J., R. T. Zegers, S.J., F. J. Fitzpatrick, S.J., C. J. Eller, S.J., C. E. McCauley, S.J., J. H. Keneally, S.J., M. V. Baldwin, S.J., and J. F. Cohalan, S.J., leader of the group.

4—Williams Observatory, Hood College, Frederick, Maryland. F. F. Marsh.

5—Observatory of J. L. Woods, Sykesville, Maryland. P. S. Watson, P. G. Crout (5C), W. H. Pitcher.

6—Glenolden, Pennsylvania. F. W. Smith.

7—Bucknell University, Lewisburg, Pennsylvania. Students under leadership of Paul Benson: F. M. Noecker, Jr., G. Ross, J. Meyer, W. Morris, C. Schaef.

8—Rutherford, New Jersey. J. S. Andrews.

9—Piermont, New York. G. P. Kirkpatrick.

10—Haverford College, Haverford, Pennsylvania. Students under leadership of Professor H. V. Gummere: R. Hutchinson, P. H. Miller, H. S. Huntington, F. N. Rolf, T. Edwards, D. D. Dunn, S. Hollander, W. N. Huff, A. B. Boggs, W. G. Emlen, G. Peirce, P. M. Whitman, Hale, Stayer, Beck.

11—North Hills, Pennsylvania. T. K. Tomkins.

12—Drexel Hill, Pennsylvania. M. L. Evons.

According to the original plans, observations were to be made from 12:00 to 16:00 hours on November 15-16 and 16-17, the center of observations for all stations being somewhere near Lancaster. Observations were also made on November 14-15 from stations No. 1, 6, 8, and 9, but no duplicates were observed. Work on November 15-16 was seriously handicapped by cloudy skies at station 7 from 12:00 to 16:40. They plotted meteors after that time, but no other stations were then working.

The accompanying table gives the heights of 46 meteors, the columns in order being serial number, date, Eastern Standard Time, average estimated magnitude, the beginning height and the average deviation from the mean, the end height and average deviation, the class of the meteor (Leonid or Sporadic), and numbers of stations contributing observations. The method used for computation was the graphical construction with altitudes and azimuths, the first method described in A.M.S. Reprint No. 11. We have omitted from the table meteors for which the average deviation was greater than twenty per cent of the height.

No.	1934 Nov.	E.S.T. h m s	Mag.	Beginning Height km.	End Height km.	Class	Stations
1	15-16	12:46:24	4	166± 0[1]	134± 0[1]	L	1C, 3
2		13:04:00	2	..	65 1	S	3, 10
3		13:05:32	3	152 8	113 15	L	1C, 3
4		13:24:13	1.5	154 33	117 4	S	1W, 5
5		13:27:09	3	..	67 7	S	1C, 3
6		13:38:33	2.5	68 8	58 4	S	1W, 3, 10
7		13:54:02	2.3	121 6	99 8	S	1C, 2, 3, 5C
8		13:56:27	4	116 ..[2]	103 ..[2]	L	1C, 3
9		13:58:06	5	86 9	74 6	S	3, 10
10		14:05:14	1	202 18	96 17	L	1B, 3, 5C
11		14:17:40	3	97 19	69 5	S?	3, 5, 10
12		14:21:49	0.5	156 27	121 19	L	1C, 2, 3, 5C
13		14:24:27	4	85 11	71 6	S	1C, 3
14		14:38:51	3	79 8	51 3	L	1B, 3
15		15:02:38	3.5	121 7	95 4	L?	1C, 3, 4
16		15:04:45	3	109 2	88 3	L?	1W, 4
17		15:06:13	3	142 18	..	L	5, 6
18		15:06:30	4	117 6	85 1	L?	1C, 3
19		15:12:59	5	92 9	90 11	S	1C, 3
20		15:15:06	1.5	155 ..[2]	69 ..[2]	L	4, 12
21		15:19:41	2	124 9	93 15	S?	3, 10
22		15:30:37	3	225 44	201 38	S	1W, 4
23		15:30:46	3	94 14	70 11	L	3, 6
24	16-17	13:02:02	0.5	107 14	69 9	S	1C, 3, 5
25		13:09:05	1.7	161 22	155 14	L	1B, 1C, 3, 5
26		13:48:26	2.5	111 15	110 8	L	1C, 3, 5
27		13:49:25	1	91 12	87 6	L?	7, 10
28		14:03:29	2	147 3	94 2	L	5, 11
29		14:19:39	4	184 4	110 14	L	1B, 3
30		14:25:32	3.7	147 26	124 13	L	1B, 2, 3, 6
31		14:25:49	4	102 8	67 2	S	1B, 3
32		14:30:40	3	91 5	67 4	S	1C, 5, 6
33		14:33:23	5	107 18	95 8	L	1C, 3
34		14:45:16	1	85 15	71 2	L	7, 10
35		14:56:10	3	143 20	118 22	S	4, 6
36		14:59:29	4	76 13	52 1	S	1B, 3
37		15:03:16	4	84 7	74 3	L	7, 10
38		15:06:35	3	81 13	66 8	L?	7, 10
39		15:10:00	5	89 8	76 2	L?	7, 10
40		15:17:20	3	94 11	73 9	S	7, 10
41		15:19:10	3.5	131 22	109 22	L	1B, 3, 4
42		15:30:12	0	113 24	89 17	L	1C, 3, 5
43		15:33:58	4	88 1	..	L	7, 10
44		15:39:09	1.5	142 2	104 12	L	5, 11
45		15:52:36	2	181 29	97 4	L	1C, 3
46		16:19:45	1	186 29	70 14	L	5, 11

[1] By this method a separate height is found from each station. This is the average of the deviations from the mean.
[2] Graphical solution; no mean deviation found.

Mean beginning and end heights are as follows:

	Beginning km.	No. of Meteors	End km.	No. of Meteors
Leonids	128.9	29	94.6	27
Sporadic meteors	111.0	15	85.3	17

These means for Leonids are within a kilometer of the mean heights for Leonids dimmer than first magnitude observed by the local network in 1932. The mean

beginning height differs by about a kilometer from the value found for 1933 Leonids observed from local stations, and the mean end height by about 4 km. The means for sporadic meteors are within 10 km of the values found in 1932 and 1933.

On the basis of three years of experience with coöperative Leonid campaigns, we are inclined to believe that a *network* of coöperating stations is more useful for observations of long-enduring trains than for meteor heights. Although the network should give more accurate heights, it does not in practice do so, and it unnecessarily complicates computing labors. For heights, we recommend using two or at most three stations, and concentrating on getting experienced plotters and careful timers. Having two or more plotters at each station is an advantage, whether they plot the same meteors in order to get more accurate paths or plot different meteors in order to get more complete records for the observing time.

For these computations the assistance of Mr. B. S. Whitney is gratefully acknowledged. Observations by the state groups in other parts of the country are now being examined. We hope to have some heights ready for publication in the June-July Meteor Notes.

Flower Observatory of the University of Pennsylvania,
Upper Darby, Pennsylvania, 1935 April 5.

The Meteor of November 24, 1934

By C. C. WYLIE

This spectacular meteor, which fell at about 5:50 A.M., attracted considerable attention over northern Illinois and eastern Iowa. The newspapers reported it in Keokuk, Davenport, and Iowa City in Iowa; and in Moline, Galesburg, Pawpaw, LaSalle, Sterling, and Aurora in Illinois; and in Hannibal in Missouri. Without doubt there were other newspaper notes which did not come to our notice.

The best determinations of the apparent path are probably for Iowa City and Keokuk. Mr. Bemrose Boyd visited Keokuk less than a week after the fall of the meteor and measured the angles for six observers. At Iowa City, Iowa, Miss Ethel Roorda and the writer interviewed four observers about a week after the fall of the meteor. Stormy weather prevented our making the interviews immediately. At Beloit, Wisconsin, Professor R. C. Huffer measured the angles for four observers. His measurements were taken later than those in Iowa City and Keokuk. At Monmouth, Illinois, Professor Lyle W. Finley measured the angles for two observers soon after the fall of the meteor. At Sterling, Illinois, the writer measured up the angles for one observer, and with the assistance of Messrs. Arthur DeVany and Bernhardt Nordbloom measured those for a second observer. Near Rock Falls, the writer measured the angles for two observers. At the following places the angles were measured for one observer; at West Branch, Iowa, by the writer with Bemrose Boyd, (two observers who saw the meteor together); at Davenport, Iowa, by Arthur DeVany; at Bettendorf, Iowa, and Galt, Illinois, by Arthur DeVany and Bernhardt Nordbloom; at Custer Park, Illinois, and Elwood, Illinois, by Frank Preucil, and at Earlville, Illinois, by L. D. Hampton.

Stormy winter weather interfered with the making of interviews on this meteor. We had the names of several observers in the country near Iowa City, Davenport, and elsewhere, who would have been interviewed had the country roads been reasonably passable. We made the trip to Sterling, Illinois, when the

weather was good and the country roads in that vicinity passable. Our plan was to interview observers both north and south of the bursting point. The interviews at Sterling, Galt, and Rock Falls, north of the bursting point, were obtained as planned, but a glaze storm put about three inches of ice on everything before the communities just south could be visited.

Light and Bursting

We obtained eleven independent estimates on the light of the meteor. Two observers who saw the meteor through windows from Iowa City believed that the light was greater than daylight. Five observers reported that the illumination of the landscape was greater than that by the full moon. Two estimated that the illumination was about half way between full moon and full daylight. One estimated that the illumination was about equal to that of the full moon, and a single observer reported that the light was probably less than the full moon. The meteor was brightest at a low altitude, and the efficiency of the nearly horizontal rays in illuminating the landscape was not great. The rays struck the walls of bedrooms nearly perpendicularly, however, and this probably accounts for the indoor estimates of light being higher than the outdoor estimates. Some allowance must be made for the fact that a sudden light at night appears brighter because the pupils of the observers' eyes are open because of relative darkness. However, the moon was shining at the time of this meteor, being about three days past full. The landscape was already illuminated, and as there was undoubtedly a great increase in light, the meteor was probably four or five magnitudes brighter than the full moon. We have adopted —17 as the probable magnitude.

Most observers referred to the meteor bursting into pieces, but many did not mention the number of pieces and there was not perfect agreement where the number was given. At Iowa City, two observers who each saw the meteor through a window agreed that the meteor burst into four pieces, three about the same size and the fourth appearing perhaps twice the diameter of the other three. At LaSalle, one observer reported that the meteor burst into three pieces. Near the end point, the observers from Galt, Rock Falls, and Sterling who were interviewed about six weeks after the fall of the meteor gave two to five or six as the number of pieces.

The Bursting Point

For determining the bursting point a mean azimuth was adopted for each of the following places: Keokuk, Iowa City, Beloit, Bettendorf, Sterling, Monmouth, Rock Falls, Galt, and Earlville. The projection of the adopted bursting point is longitude 89° 37′.1, and latitude 41° 29′.5. This is a point about 4½ miles distant in a north and west direction from the town of Ohio, Illinois. Residuals for each community were formed by measuring the perpendicular distance from this adopted point to the azimuth line from that community. From these residuals the probable error was formed according to the usual formula and found to be ±1.6 miles.

The height of the bursting point was found by adopting an angular altitude from the measurements at each of the following: Keokuk, Iowa City, Rock Falls, Galt, Sterling, and Earlville. It was noticeable that the Galt, Sterling, and Rock Falls interviews, which were taken in early January, and for which there was no good landmark to fix the altitude, gave lower heights than the earlier but more distant measurements at Keokuk, Iowa City, and Earlville. Weighting these altitudes according to the square root of the number of observations entering into each, the height of the bursting point was found to be 8.9 miles.

The Radiant

For determining the radiant a slope of path was adopted from the measurements at each of the following: Iowa City, Keokuk, Monmouth, and Beloit. Because the nearer interviews in Sterling, Galt, and Rock Falls were made so late it was thought better not to use them for the radiant work, although they were of the greatest importance in determining the position of the bursting point. The apparent slopes and the weights assigned were:

	Slope	Weight
Iowa City	75°.5	3
Keokuk	26.0	2
Monmouth	30.0	1
Beloit	20.0	1

Beloit had as many observations as Iowa City, but the interviews were made after a greater lapse of time, and memory on a low angle appears to be less reliable than on a slope near ninety degrees. The paths projected backwards, however, intersect in a small area, so that the weighting makes little difference in the adopted radiant. This was found to be azimuth 104°.2 from the south point, and altitude 18°.8. This is the radiant as seen from the projection of the bursting point. The probable error was found to be 0°.4.

The ground point was found to be longitude 89° 7'.8, and latitude 41° 23'.9. The projected distance from bursting point to ground point is 26.1 miles. The radiant, as seen from the ground point, and corrected for zenith attraction, is azimuth 104°.5, altitude 14°.3. Reduced to right ascension and declination, and corrected for diurnal aberration also, this is right ascension 62°.1 and declination +19°.9.

The Point of Noticeable Illumination

The point of appearance for this meteor is not so well determined as for some on which we have worked. Many of our best observers failed, because of trees or buildings, to see the beginning. For Bettendorf, Sterling, Galt, Rock Falls, and Earlville the meteor was coming in the general direction of the observer, and a very small change in the estimated azimuth would make a big change in the estimated point of appearance. However, we have for the point of appearance one observation at Iowa City, one at West Branch (two observers who saw it together), two at Keokuk, and one at Beloit. These agree reasonably well, and indicate a point of appearance a little northwest of Iowa City. This is the point of noticeable illumination. It is where the meteor became bright enough to cause people, who were outdoors and away from lights, to look up. The projection of the adopted point is longitude 91° 47'.4, latitude 41° 51'.0. The height in miles of the path at this point is 49.3 miles. The distance along the path from illumination to bursting is 122.0 miles. The projected distance is 114.6 miles.

The Velocity

For determining the velocity, we need in addition to the path, the duration. At Iowa City the meteor appeared while one observer was under a tree. He continued walking along the sidewalk without change of pace, and saw the last part of the path of the meteor. At Keokuk and at Galt, observers walked a short distance to see the end of the meteor. We had each of these observers re-enact more than once what he did while the meteor was falling, and the time was taken with a stopwatch. A few time intervals were determined by having the observer point with a yardstick to the place in the sky where the meteor was first seen, and follow the path, as he recalled it, to bursting point.

The weights assigned each community depended in part on the number of durations determined. Additional weight was given to the durations where there was definite action, including walking. Additional weight was also given to the durations determined at the earliest interviews. The adopted durations and weights are:

	Duration	Weight
Iowa City	8.2 sec.	3
Keokuk	11.0	3
Monmouth	4.0	2
Galt, Sterling,and Rock Falls	6.5	2
Beloit	3.4	1

This gives for the duration from illumination to bursting 7.45 seconds. Using this figure for the duration, and the length of path from illumination to bursting, the resulting velocity is 16.4 miles per second. For some durations, however, it was thought best not to use the full length of path. Using the lengths apparently observed in these cases, the observed velocity through the atmosphere was found to be 16.1 miles per second, with a probable error of ±1.1 miles per second. Correcting for the earth's attraction, the geocentric velocity was determined as 14.6 miles per second. By the usual formula, the heliocentric velocity was derived, and found to be 23.3 miles per second. This is definitely under the parabolic velocity, and so the meteor presumably came from the solar system.

Detonations

The detonations following the appearance of this meteor resembled thunder, and attracted considerable attention in Davenport, Moline, and Rock Island. The newspaper accounts of the meteor all referred to the detonations. South of Rock Falls, Wm. L. Prins and others heard two booms less than a second apart, like claps of thunder. Detonations were almost certainly heard as far back along the path as West Branch, Iowa. Two young men who were tending their traps out in open country, saw the meteor, and sometime after its disappearance, heard a roll of thunder. They heard only a single boom, like a clap of thunder. These young men were interviewed on the spot, soon after the fall and attempted to reproduce their actions between the appearance of the meteor and the hearing of the thunder. The time interval was, in this way, determined as 1 minute, 41 seconds. The older of the two young men, however, remarked that they probably had spent more time looking at their traps on the morning of the meteor, than they did when attempting to re-enact the scene. It was getting dark at the time of the re-enaction, and the traps could not be seen very well. Because of the darkness a second timing was not attempted. We were able to get no timing on the detonations heard in Davenport and Moline. South of Rock Falls, however, Mr. Wm. L. Prins, mentioned above, was interviewed. He had seen the meteor in a pasture, then walked west to a road and was going south on the road when the claps of thunder were heard. Mr. Prins was timed, walking from where he recalled seeing the meteor to where he recalled hearing the detonations. The time interval was found to be 80 seconds.

If we assume the average temperature of the air through which the sound waves were traveling, to have been —30° Fahrenheit, the velocity of sound would have been about 1050 feet per second. At that speed, the sound would have reached Mr. Prins in 55 seconds, instead of 80 seconds. It would have reached the boys near West Branch in about 3 minutes, 20 seconds, instead of 1 minute, 41 seconds. The discrepancy of 25 seconds for Rock Falls is not bad considering that more than a month had elapsed, and the observer had to recall how long he

stood still after the disappearance of the meteor, how fast he walked, where he was when the meteor appeared, and where he was when the thunder was heard. For West Branch, the computed interval is about double that observed, but, as we have said, the older of the two young men suspected that they had moved too fast in re-enacting their actions, although no hint was dropped as to what duration was expected.

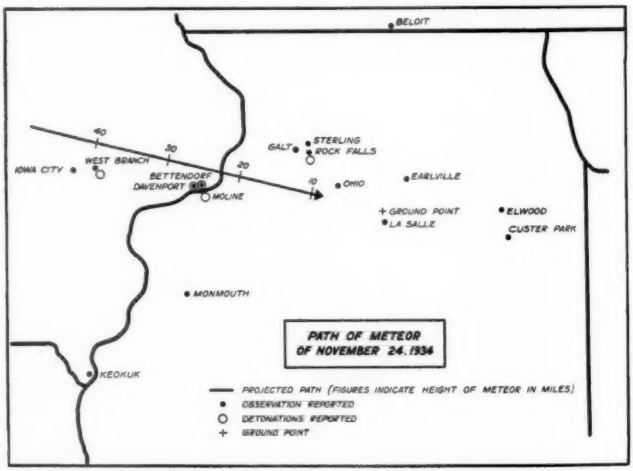
Interviewing Observers

The first report received from Davenport is an interesting illustration of the difference between estimates and measures. Mr. DeVany's first report on a Davenport observation contained estimates of direction, the observer not being interviewed where he saw the meteor. A little later the observer was interviewed standing where he saw the meteor. The measured azimuth of disappearance differed by 84° from the estimated. Using our adopted end point, the measured azimuth is in error by 13°, less than one fifth the error of the estimate.

A report from La Salle is an illustration of the tendency to carry the path much too far. The report reads as follows:

> "On the morning of November 24, while I was on my way to work, walking directly westward . . . my attention was directed to the bright gleam of a strong light . . . appearing from the west and slightly north at about 6:00 A.M. . . . When almost directly overhead, there was an explosion and breaking up of the main body of the meteor . . . It is my opinion that many fragments of the meteor might be found to the south and possibly at an angle to the east from La Salle."

We did not visit La Salle, and so we cannot say how much an interview would have changed this report, but it should be said that two or three other re-



ports from La Salle stated that the meteor fell west of the town. (See the accompanying map for the direction of the end point from La Salle.)

One of the Iowa City interviews is an illustration of a "mirror-vision" effect found on almost every well-worked meteor. The azimuth of the end point agreed approximately (within 9½°) with the mean of the other measures. But the ob-

server pointed out the path as crossing the southern sky, while according to all other Iowa City and West Branch observers, the meteor crossed the northern sky. Observations which interchange right and left are, of course, rejected.

The accuracy attained when observers are interviewed, using only yard sticks to draw the angles, is illustrated by the residuals and probable errors in this paper and in the paper in the April issue. It is also illustrated by the measures made on this meteor at Iowa City and at Keokuk, the only places where more than two azimuths of the end point were secured. For Iowa City, three out of the four have an extreme spread of less than two degrees. The fourth is the mirror-vision path previously referred to, and rejected. For Keokuk, four out of the six have an extreme spread of 5½ degrees.

ACKNOWLEDGMENT

The computers who have worked on this meteor are, in order, Ethel Roorda and L. R. Wylie. The work has been supported in part by a grant from the Graduate College of the University of Iowa, and in part by a grant from the J. Lawrence Smith Fund of the National Academy of Sciences.

SUMMARY

The accompanying map shows the projected path of the meteor. The height of the meteor in miles is indicated, and the places from which detonations were reported is also indicated. The following presents in tabular form the results we have obtained.

Longitude end point	89° 37′.1 ± 1′.4
Latitude end point	41° 29′.5 ± 1′.4
Height end point	8.9 miles
Longitude appearance	91° 47′.4
Latitude appearance	41° 51′.0
Height of appearance	49.3 miles
Length path	122.0 miles
Projected length	114.6 miles
Apparent velocity	16.1 miles ± 1.1 miles
Heliocentric velocity	23.3 miles
Azimuth radiant	104°.2 ± 0°.4
Altitude radiant	18°.8 ± 0°.4
Azimuth corrected radiant	104°.5
Altitude corrected radiant	14°.3
R. A. corrected radiant	62°.1
Decl. corrected radiant	+19°.9
Estimated magnitude	—17

University of Iowa, Iowa City, Iowa, April 19, 1935.

Contributions from the Society for Research on Meteorites

Edited by FREDERICK C. LEONARD, President, *and* H. H. NININGER, Secretary

Appointment of the Advisory Committee for the Proposed Meteoritical Institute

At the Pittsburgh meeting of the American Association for the Advancement of Science, in December, 1934, a paper, "Proposing an Institution for Meteoritical Research,"[1] was presented by Secretary H. H. Nininger of this Society. The

[1] Abstracted in *Geol. Soc. Amer., Prel. List of Titles and Abs. of Papers to be offered at the 47th Ann. Meet., Rochester, N. Y.*, p. 97, 1934.

paper contained not only a proposal for the establishment of a Meteoritical Institute (as this might be called) but also an outline of the program which would presumably be undertaken by such an institution. It had been suggested that the President of the Society appoint an Advisory Committee for the Proposed Meteoritical Institute, this Committee to consist, first, of all the Officers and Councilors of the Society, and, second, of a number of specially named Members. The President took pleasure in acting on this suggestion, and, under date of 1935 March 15, in requesting the following Officers, Councilors, and Members of the Society, to serve on the Committee:

†Mr. L. F. Brady, Mesa Ranch School, Mesa, and Museum of Northern Arizona, Flagstaff, Ariz.
†Dr. G. M. Butler, University of Arizona, Tucson, Ariz.
†Prof. R. E. Crilley, Iowa Wesleyan College, Mt. Pleasant, Ia.
Dr. C. Fisher, American Museum of Natural History, New York, N. Y.
*Dr. W. F. Foshag, United States National Museum, Washington, D. C.
Dr. C. H. Gingrich, Carleton College, Northfield, Minn.
Dr. E. S. Haynes, University of Missouri, Columbia, Mo.
Prof. M. A. R. Khan, Osmania University College, Hyderabad, Deccan, *India.*
*Dr. F. C. Leonard, University of California at Los Angeles, Los Angeles, Calif.
Dr. K. F. Mather, Harvard University, Cambridge, Mass.
†Dr. F. R. Moulton, Chicago, Ill.
Dr. F. K. G. Müllerried, México, D. F., *México.*
†Mr. H. W. Nichols, Field Museum of Natural History, Chicago, Ill.
*Prof. H. H. Nininger, Nininger Laboratory and Colorado Museum of Natural History, Denver, Colo., *Chairman of the Committee.*
Dr. C. P. Olivier, University of Pennsylvania, Upper Darby, Pa.
Dr. L. T. Patton, Texas Technological College, Lubbock, Texas.
Dr. T. T. Quirke, University of Illinois, Urbana, Ill.
Dr. E. H. Sellards, University of Texas, Austin, Texas.
Dr. L. J. Spencer, British Museum of Natural History, London, *England.*
†Dr. W. T. Whitney, Pomona College, Claremont, Calif.
*Dr. C. C. Wylie, University of Iowa, Iowa City, Ia.

*Officer. †Councilor.

A mimeographed abstract of the aforementioned paper was sent to every person asked to join the Committee. Because the Committee is large, and its Members are widely dispersed, it has been decided that *five* (5) shall constitute a quorum at any meeting regularly called by the Chairman. The Secretary of the Society will act as the Chairman of the Committee, which will elect a Vice-Chairman and a Secretary when it convenes at the Third Annual Meeting of the Society, to be held in connection with the meeting of the A.A.A.S., at the University of Minnesota, Minneapolis, in June, 1935.

FREDERICK C. LEONARD, *President.*

Advance Notice of the Third Annual Meeting of the Society

The Society for Research on Meteorites will hold its Third Annual Meeting at the University of Minnesota, Minneapolis, on Wednesday, June 26, and Thursday, June 27, 1935, in connection with the summer meeting of the American Association for the Advancement of Science.

The forenoon program will begin at ten o'clock and the afternoon program at two o'clock on each of the aforesaid dates. Papers on various aspects of meteoritics will be read by members. A roll call of committees will be a feature of the meeting, and all chairmen are requested either to bring with them or to send to the Secretary, reports of the activities of their respective committees.

The afternoon session of Thursday, June 27, will be devoted to a meeting of the special Advisory Committee recently appointed by President Leonard to consider the merits of the Proposed Institution for Research on Meteorites, or Meteoritical Institute. The members of the Advisory Committee, especially, will please to take note of this announcement.

All members of the Society who desire to present papers at the Minneapolis meeting, regardless of whether they will be able to attend it or not, are cordially invited to do so, but should see that the titles of their contributions are in the hands of the Secretary *not later than May 15, 1935.*

H. H. NININGER, *Secretary.*

Erratum on p. 253.—The first word in the first line under the heading, "List of New Members of the Society," should be "Continued" instead of "Contributed."

Secretary's Office: The Nininger Laboratory, 1955 Fairfax Street, Denver, Colorado.

Editorial Office: The Department of Astronomy of the University of California at Los Angeles.

Meteor Observed

On the night of March 30, while I was observing Nova Herculis for the purpose of estimating its magnitude, a bright fireball appeared just below γ Draconis, and in a path perpendicular to the horizon it descended like a fiery plummet dropped from some captive balloon, increasing rapidly in brilliancy until as bright as Venus at its present phase, then suddenly fading out after a 15° flight about 3° west and a trifle below Vega. Its color was a bright yellow, its train of sparks quickly vanished, and the time was 10:46 P.M., Pacific Standard Time. While I have seen many more spectacular meteoric apparitions, this was especially striking because it appeared in the very spot I was watching, making the circumstances very favorable for observation.

ROBERT E. MILLARD.

3908 Council Crest Drive, Portland, Oregon.

Notes from Amateurs

Amateur Telescope Makers of Chicago

The Amateur Telescope Makers of Chicago held their April meeting at the Adler Planetarium and Astronomical Museum, Chicago, on Sunday the 14th.

The program was an address by Dr. M. M. States of the Central Scientific Company, Chicago. The subject was "Diffraction Gratings and their Application in Optical Instruments." Dr. States explained diagrammatically what happens when light is passed through a slit and gave some of the mathematics on the subject. He also showed how plane and concave gratings function in the spectrograph. He had some replicas with fifteen and twenty thousand lines to the inch which we used to view the spectrum of a neon lamp. The audience was very much interested and Dr. States answered many questions.

The Schmidt telescope was then discussed and Professor Arthur Howe Carpenter and George E. Warner explained the principle of this interesting instrument.

WM. CALLUM, *Secretary.*

1319 W. 78th St., Chicago, Illinois.

Columbia Astronomical Association

The third in a series of monthly public meetings of the Columbia Astronomical Association of Columbia, South Carolina, was held March 28 at 8:00 o'clock in the physics lecture hall at the University of South Carolina. An interested audience of approximately 100 heard Dr. E. C. Coker of the university faculty lecture on the subject of "Our Galaxy."

It was announced that the April meeting would be held on the 30th at which time Waller Bailey, a member of the association, would give an illustrated lecture on the subject, "The Moon."

LEGARE INGLESBY, JR., *Secretary.*

Astrolab Astronomical Associates

The Astrolab Polar Cone 7-inch aperture telescope has recently been assembled and a number of photographs taken of this, Astrolab's second telescope design. For portability the mounting slips apart into two separate units weighing less than twenty pounds each. This Astrolab development will be of value to the member who wishes to carry on his observing program while away from home. The over-all length of the telescope tube is less than three feet. One feature is that the base can be fastened to a convenient tree stump, or mounted on a cement pier, or, by simply screwing in two aluminum legs, become completely portable.

The designers of this 7-inch Polar Cone Mounting have kept in mind that this telescope be so ruggedly built and so smooth in operation that it would be suitable for use in Astro-photography. A synchronous electric driving clock is now under design.

We should like to hear from those interested in becoming members and coöperating in the Astrolab program.

L. I. BUTTLES, Editor "The Astroscope."
10728 S. Artesian Avenue, Morgan Park, Chicago.
March 19, 1935.

Asteroid Notes

By HUGH S. RICE

The brighter asteroids are not very conveniently placed for observation, in general, during this period of May 10 to June 10. Planet 4 Vesta is in a region of faint stars in Aquarius, and is traveling in its apparent path, nearly eastward. On May 20 it will be in conjunction with Saturn, passing about 2° south of it, with the star 70 Aquarii between. In the next issue it is proposed to give a large chart of the path of Vesta among the stars from June 1 to the end of the year.

American Museum of Natural History, New York, April 22, 1935.

Zodiacal Light Notes

By FRANKLIN W. SMITH

On March 26 at 7:45 E.S.T., the evening Zodiacal Light was traced nearly vertically upward from the western horizon to the Milky Way. Near the horizon the northern edge touched γ Arietis and the southern edge touched λ Ceti. The axis passed 3 or 4 degrees south of the Pleiades. No trace of the light cone could be detected on the eastern side of the Milky Way.

It has not been possible to observe the Gegenschein because of unfavorable

weather conditions and that object is now probably too far south to be seen by northern observers; it will remain out of their reach until next September and October when it will be moving northeastward through Aquarius and Pisces.

In a recent issue of the *Monthly Notices of the Royal Astronomical Society*, R. B. Bousfield has given a very interesting report* of his observations of Zodiacal Light phenomena, including the light cones, Gegenschein, and light band. In addition to naked-eye observations, photometric observations made with a carefully standardized luminometer are included. These are especially important for although the Zodiacal Light has been under observation for many years, few definite measurements of its brightness have been made.

407 Scott Ave., Glenolden, Pennsylvania, April 17, 1935.

*Bousfield, R. B.: The Zodiacal Band, *M.N.*, **94**, No. 9, pp. 824-838.

General Notes

Professor E. W. Brown will go to England in June, taking with him the David B. Pickering Gold Medal of the A.A.V.S.O., which is to be awarded to Mr. J. M. Prentice for the discovery of Nova Herculis on December 13.

Mr. William Tyler Olcott, who has been spending the winter in St. Petersburg, Florida, recently suffered an attack of illness. His friends will be pleased to know that he is again much improved.

Dr. Robert M. Petrie, for the past six years a member of the staff of the Observatory of the University of Michigan, has been appointed Astronomer in the Dominion Astrophysical Observatory at Victoria, B. C., and will take up his new duties on May 1.

Professor E. A. Milne, Rouse Ball Professor of Mathematics and Fellow of Wadham College, Oxford University, was awarded the Gold Medal of the Royal Astronomical Society, at a meeting held on February 8, 1935, in recognition of his work on "Radiative Equilibrium and Theory of Stellar Atmospheres."

Mr. David B. Pickering, of East Orange, New Jersey, who considers himself merely an amateur astronomer, but who is as well informed as the professional astronomers on many phases of variable star investigations, will speak at the American Museum of Natural History in New York City on May 1, and at the Franklin Institute in Philadelphia on May 10, on the subject "Variable Stars."

The Gaertner Scientific Corporation of Chicago has recently issued two pamphlets, the one on chronographs and accessories, the other on spectrometers and accessories. These contain illustrations and descriptions of the instruments of precision which this firm is prepared to furnish. Persons interested may secure copies of these pamphlets upon request.

The American Meteorological Society will meet at Minneapolis during the A.A.A.S. summer convention June 24-29, 1935. Mr. M. R. Hovde, official in charge of the Minneapolis Weather Bureau Office, and Mr. Eric Miller, of the Weather Bureau, Madison, Wisconsin, are making the arrangements for the meeting. All persons interested are invited to attend these sessions. Moreover, Mr. Miller will be pleased to hear from any one wishing to present a paper at the sessions.

The Harvard Summer School of Astronomy, July 1 to August 10.—The summer of 1935 marks the inauguration of The Harvard Summer School of Astronomy which is to meet concurrently with the Harvard Summer School of Arts and Sciences. While, in the past, the Department of Astronomy has offered instruction in elementary astronomy during the summer and has made available facilities for research under the guidance of members of the staff of the Observatory, this reorganization of summer instruction provides particularly an extension of the opportunities for advanced instruction, for the pursuit of research, and for profit from informal conferences and colloquia. At the same time the program of elementary instruction has been extended.

The staff of the Department is enlarged during the summer session by a number of visiting astronomers who offer seminars in their special fields, contribute to the informal discussions, and assist in the guidance of those engaged in research. Their presence increases the opportunities for graduate study in all fields of astronomy and astrophysics.

FUGITIVE

In tiny molds the wary atom lay,
A million aeons marked his steady reign,
None came his way to question his domain
Nor to admire his magic symmetry.

But now keen science stirs a wondering world;
Potential, strange affinities are tried,—
As skies are combed, the cosmic rays are spied;
Old reasonings are put to newer test.

From vastness of cerulean blue, the search
Now turns to mystic depths of minuteness:
The atom will not dare withstand duress,—
This smallest part may hold the greatest truth.

Then suddenly gigantic foes assail
His long-held privacy. Sharp lightnings flash,—
Bombarding volts in rage burst forth and crash
Their stinging challenge to his dim abode.

Startled, the ready atom answers not,
Pursuit he laughs at; scorning man's fiery zeal
He sloughs a part, but will not all reveal,
Then ever burrowing, seeks a smaller home.

Man gropes for that which lies within himself,—
The fugitive atom of identity,
His being's hidden source of regnancy,
And begs to know life's ultimate design.

He pleads in vain: the ego's voice is mute,
Gives not his name nor speaks his attribute.
Spirit loves distance; shuns the overwise,
And ever vaguer grows to curious eyes.

FLORENCE E. MILCKE.

Wallingford, Connecticut.